

A New Aviation Weather Technology That Forecasts NEXRAD Reflectivity Fields

Presented By:

Mike Cetinich – Jeppesen

&

Mike Eilts – Weather Decision Technologies

For

NASA ICNS Conference

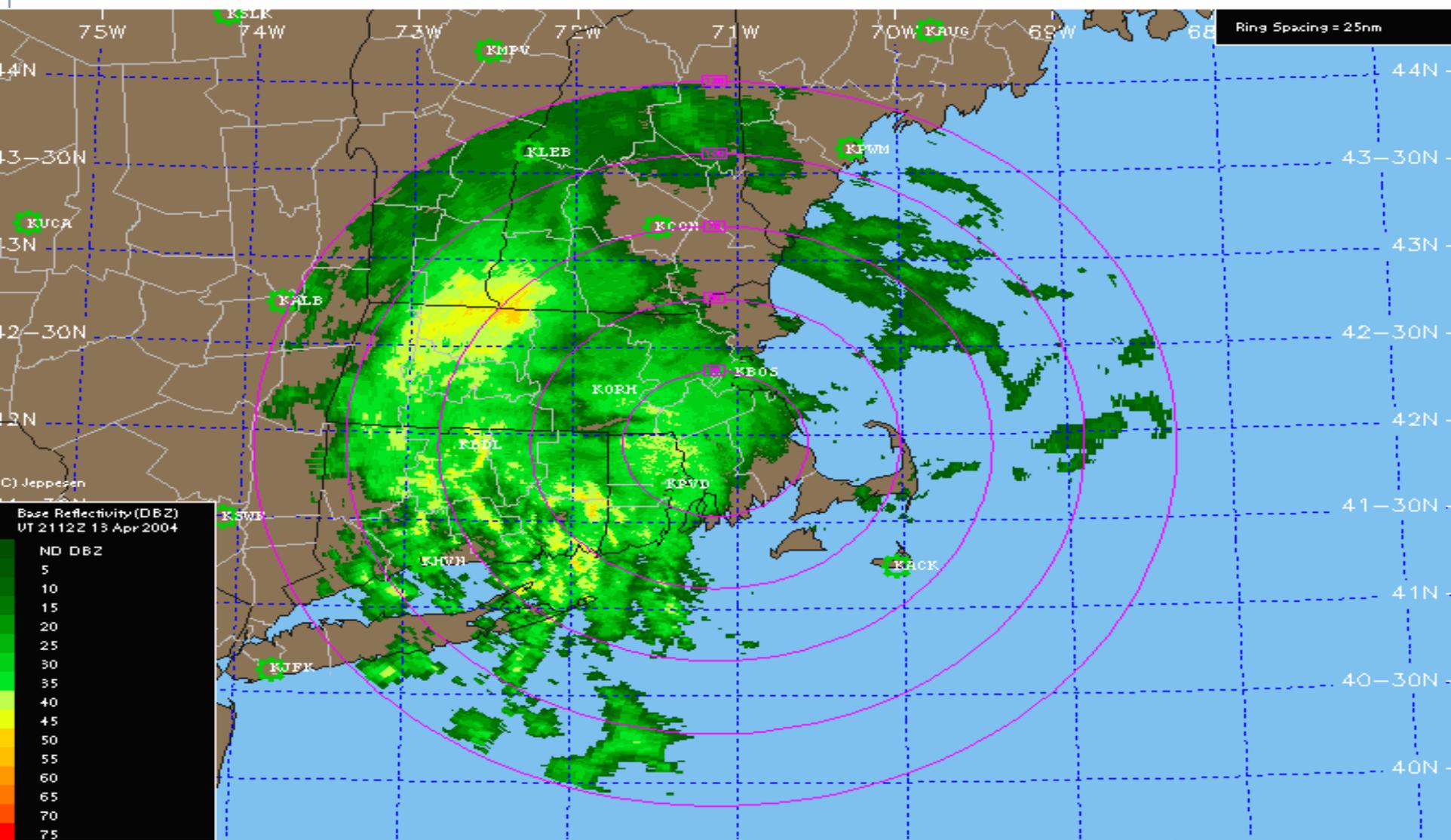
28 Apr 2004

NEXRAD Products Today

- 6-10 Minute Updates of:
 - Reflectivity (Base, Tilts, Composite)
 - Echo Tops
 - Precipitation (Storm Total, 1 Hr Total)
 - Velocity (Base Radial, Storm Relative Radial)
 - Vertically Integrated Liquid Water (VIL)
 - Velocity Azimuth Display (VAD) Wind Profile
- Single Site
- National and Regional Mosaics



Single Site Base Reflectivity



Boston Single Site Radar – Base Reflectivity VT 2112Z 13 Apr 2004

Created 2114Z 13 Apr 04

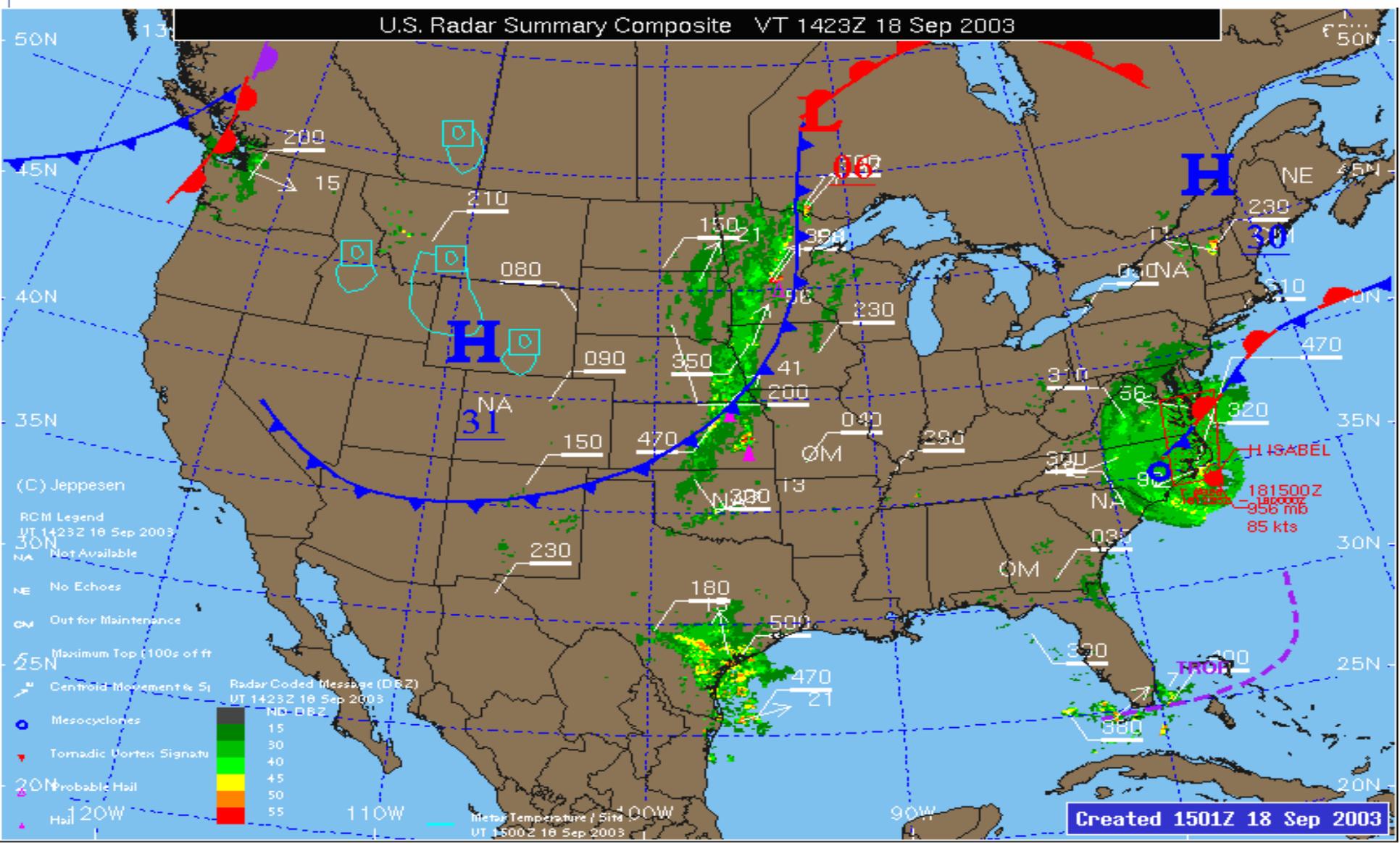


Useful NEXRAD Aviation Products

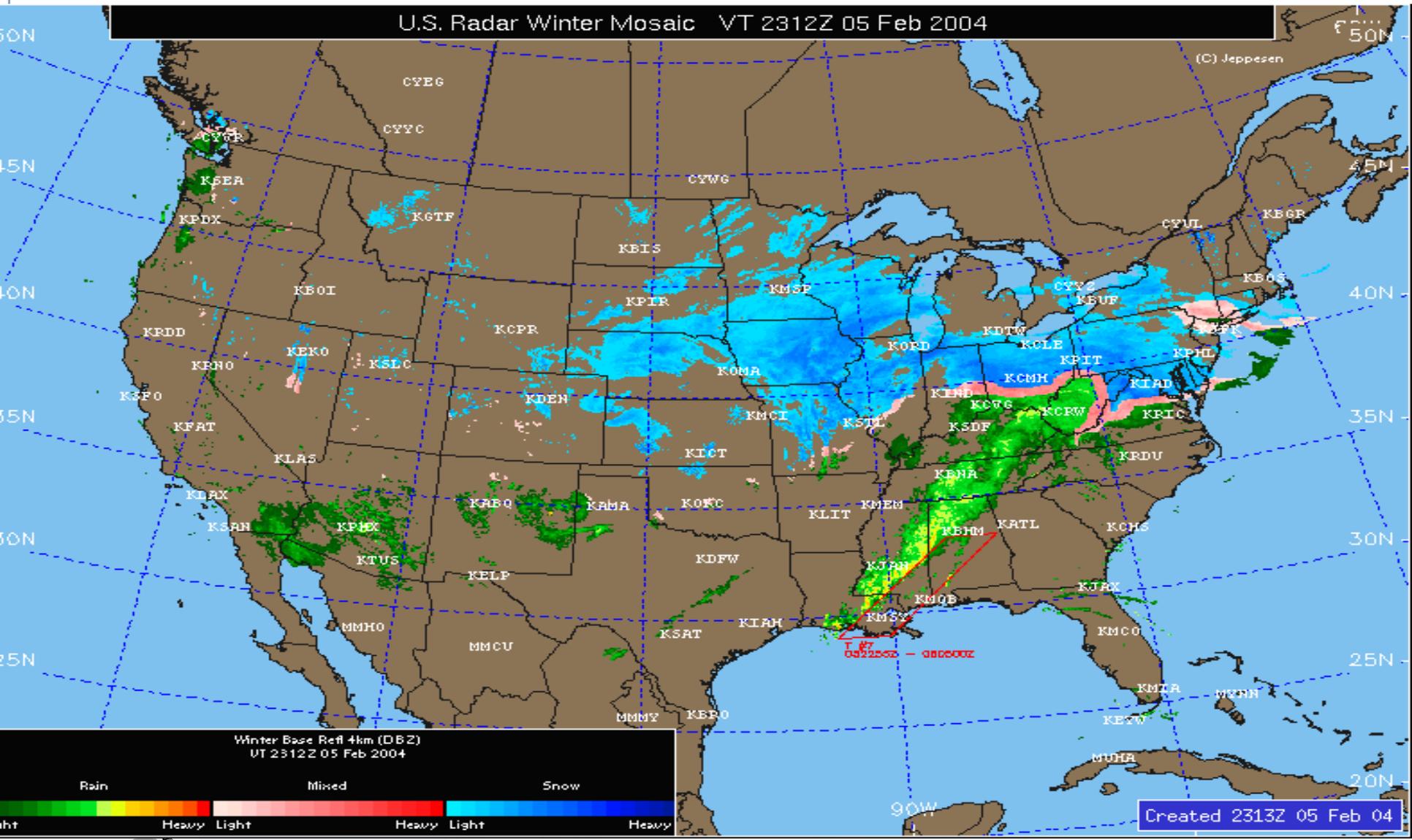
- Base & Composite Reflectivity
- Echo Tops
- Graphic RCM
- Winter Mosaic



Graphical RCM Mosaic



National Winter Mosaic



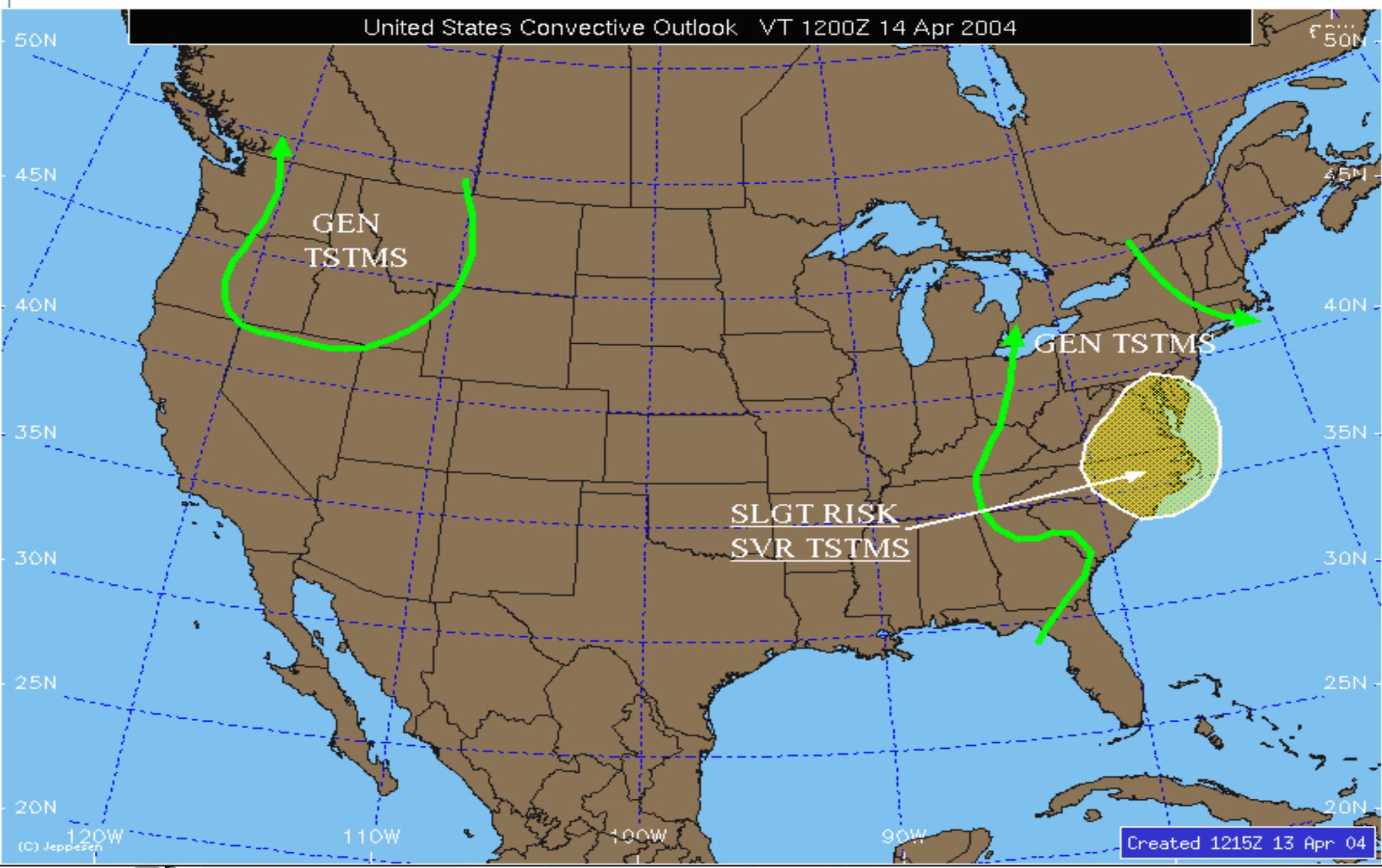
NEXRAD

Useful Display of Current and Past Conditions

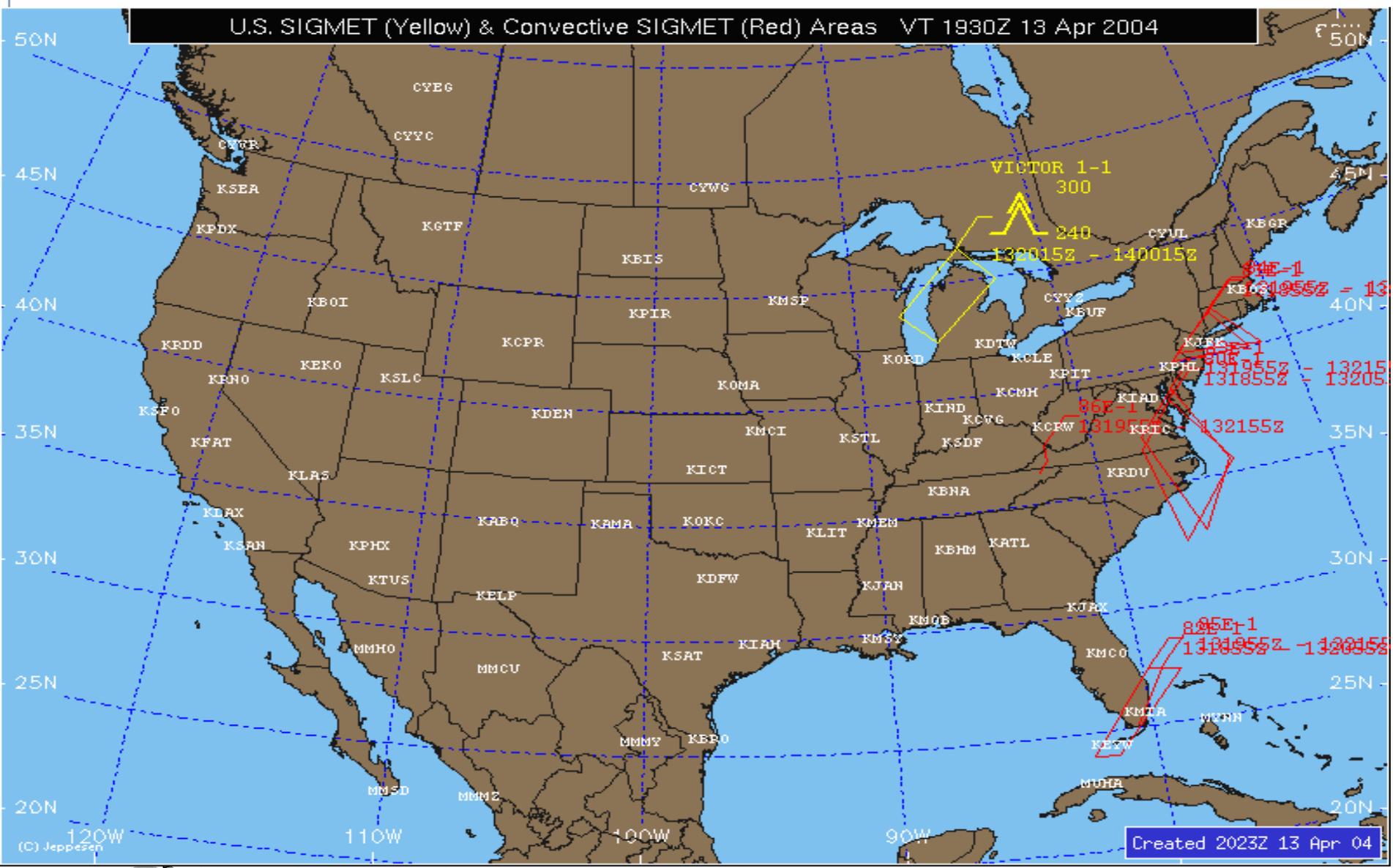
What About the Future ?



Convective Outlook



Convective SIGMET's

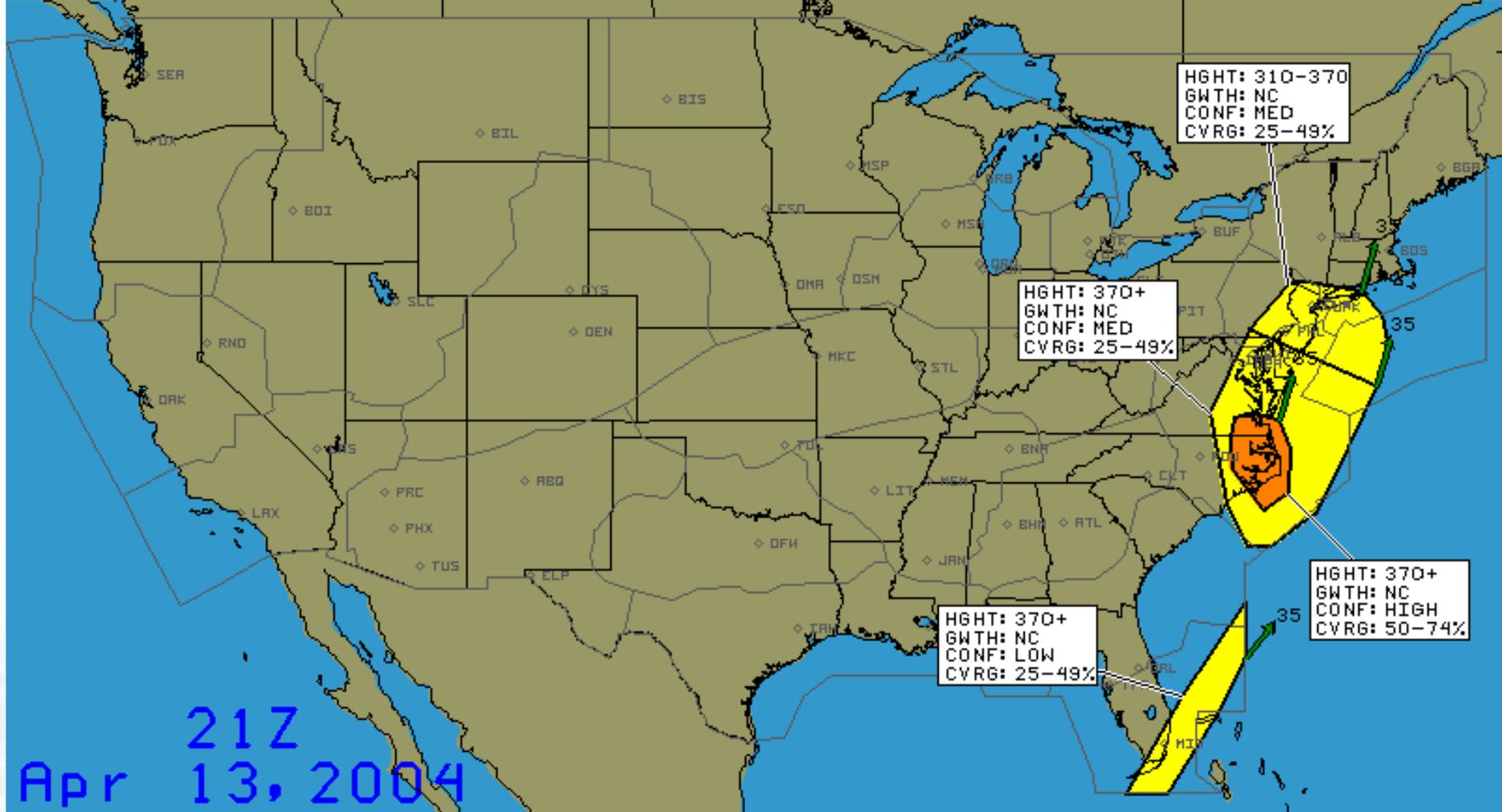


Collaborative Convective Forecast Product (CCFP)

Issuance time: Apr 13, 2004 17Z

Collaborative Convective Forecast Product

Valid time: Apr 13, 2004 21Z



AVIATION WEATHER CENTER (NOAA/NWS/NCEP)



Drawback of Current Convective Forecast Products

- Long Lead Times (AC = 12 Hr Fcst)
- Non-Frequent Updates (CCFP = Every 2 Hrs)
- Broad Geographic Areas

Lack of Specific and Timely Convective Forecasts Leads to Unnecessary Delays and Diversions.

Time & Resources Wasted = \$\$\$



A Better Solution

A NEXRAD Forecast Product

- What is the Science Behind This ?
- How Reliable is it ?
- How Often is it Updated
- How Far in the Future Does it Extend ?



NEXRAD Forecast Product

National Scale

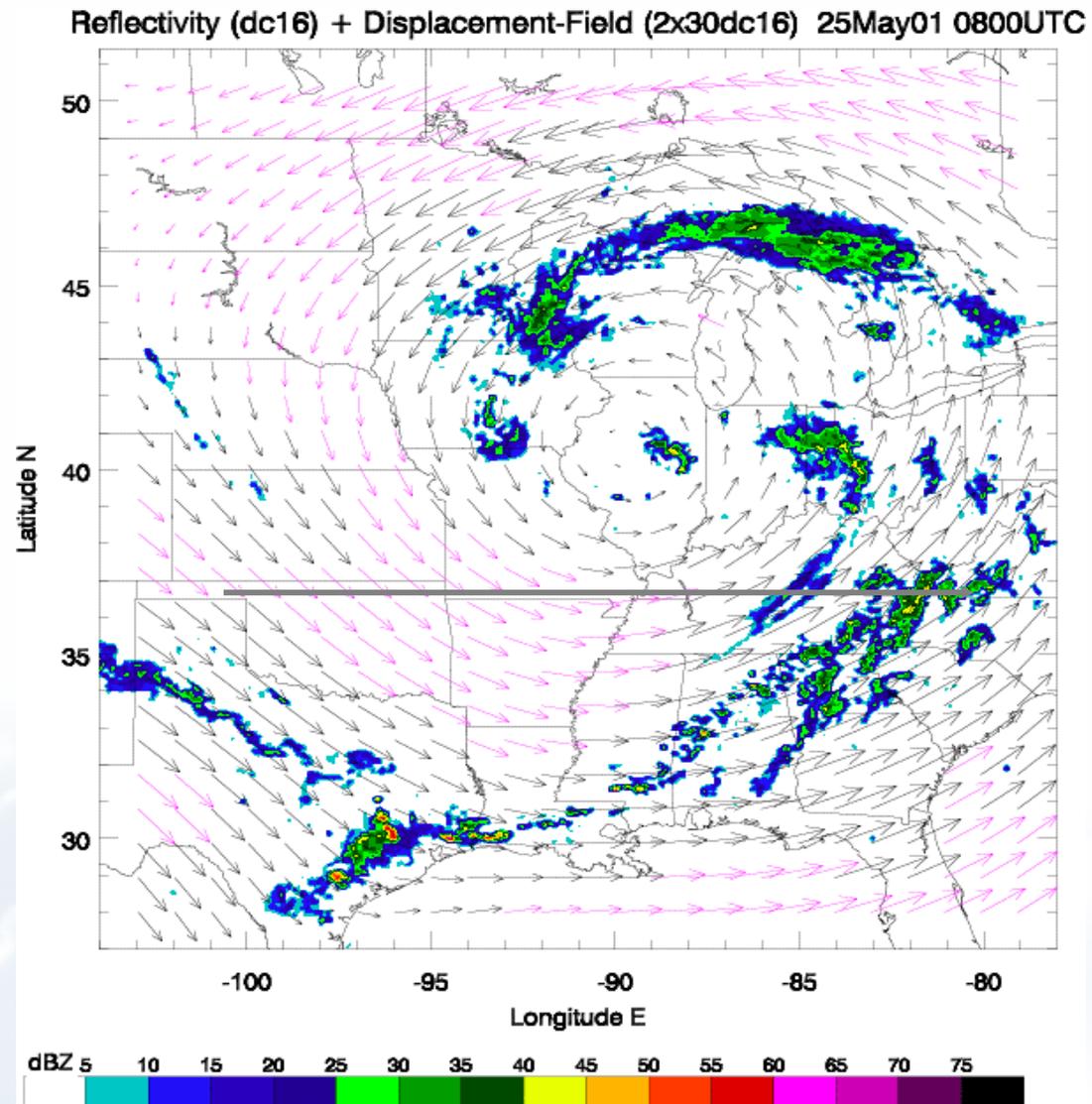
- Uses the McGill Algorithm for Precipitation Nowcasting by Lagrangian Extrapolation (MAPLE) developed by Germann and Zawadski over a decade.
- Provides nationwide and local reflectivity forecasts out to 4 hours
- Integrates WDT Proprietary ARPS numerical model forecasts for precipitation typing



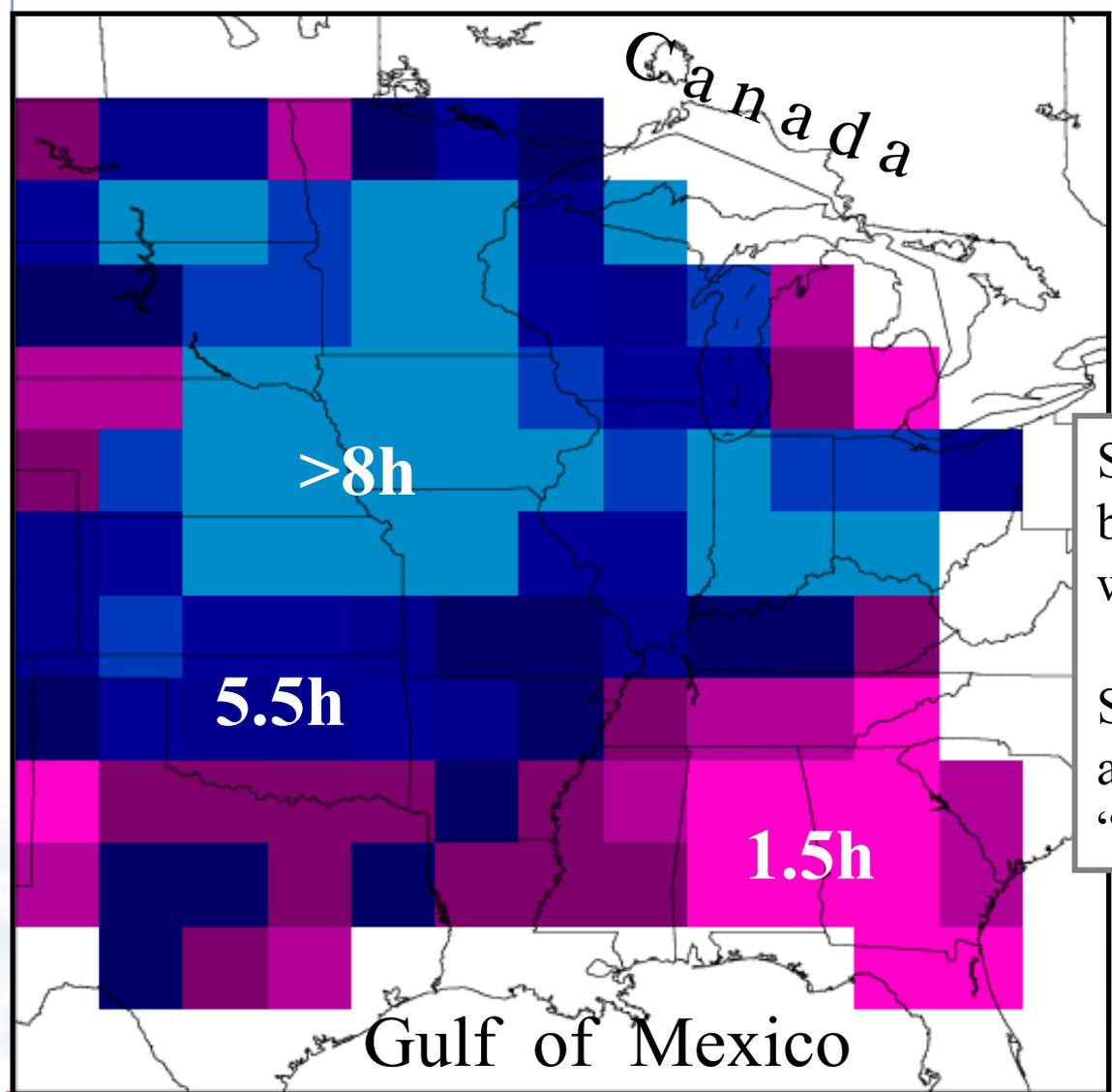
MAPLE – How it Works

- Uses history of past images for previous 90 minutes of national Nexrad mosaics
- Determines the changing scale of predictability from the past images by comparing with the current images using wavelet analysis
- Filters the non-predictable scales from the $t=0$ analysis
- Deduces stream functions (in Lagrangian space) for predictable scales and uses those stream functions to forecast reflectivity intensity and location
- Uses past growth and decay processing in forecasts
- Provides probabilistic forecasts of QPE, QPF

Example of Time Step Vector Derivation



Example of Scale Predictability



Scale predictability determined by comparison of previous forecasts with current images.

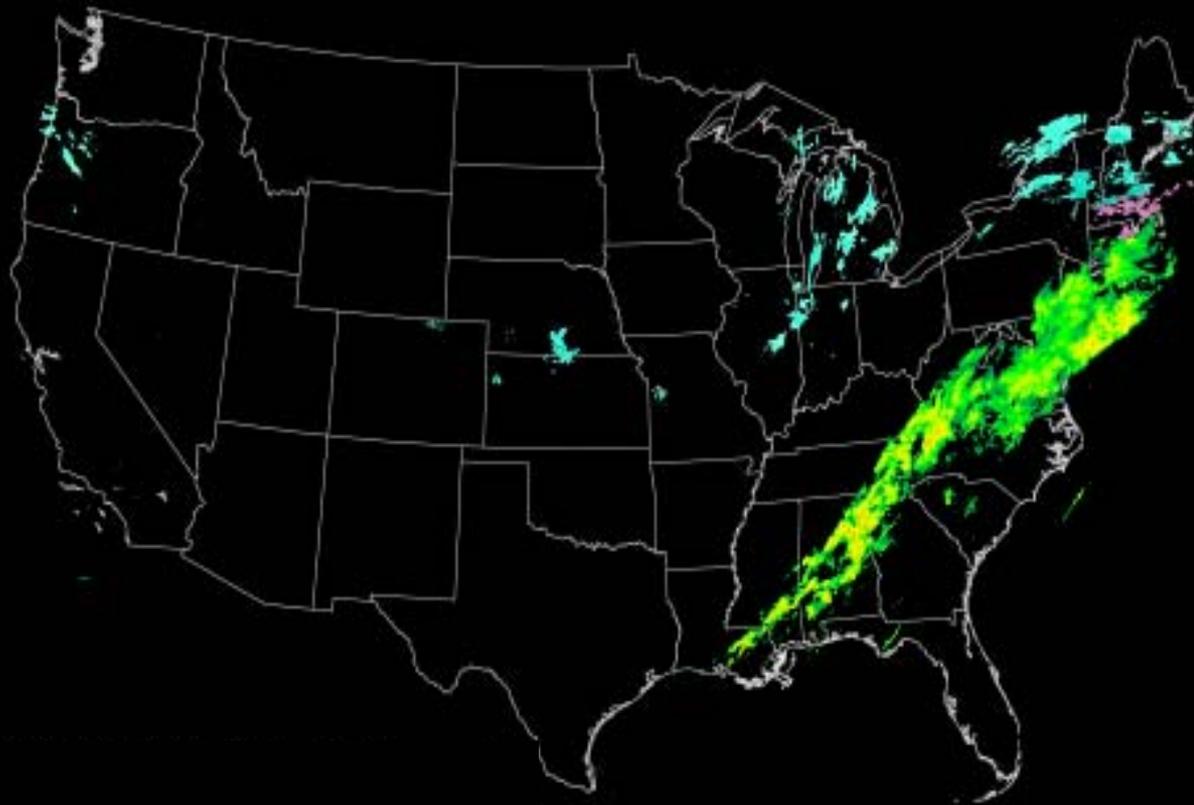
Scales are removed in the forecast after exceeding their derived "predictability" flag

WDT MAPLE Enhancements

- Moved MAPLE from research environment to operational environment running on Linux OS
- Implemented the ability to read/write various operational formats
- Integrated MAPLE forecasts with numerical model output from the Advanced Regional Prediction System ARPS (can also use WRF) to produce precipitation type forecasts
- Implemented variational Z-R and Z-S relationships to produce QPF for nowcasting and hydrological applications



NEXRAD Forecast Product



NEXRAD Forecast Product

15 Minute Forecast



01-05-2004 1636 UTC +15 min

NEXRAD Forecast Product

30 Minute Forecast



NEXRAD Forecast Product

45 Minute Forecast



NEXRAD Forecast Product

60 Minute Forecast



NEXRAD Forecast Product

75 Minute Forecast



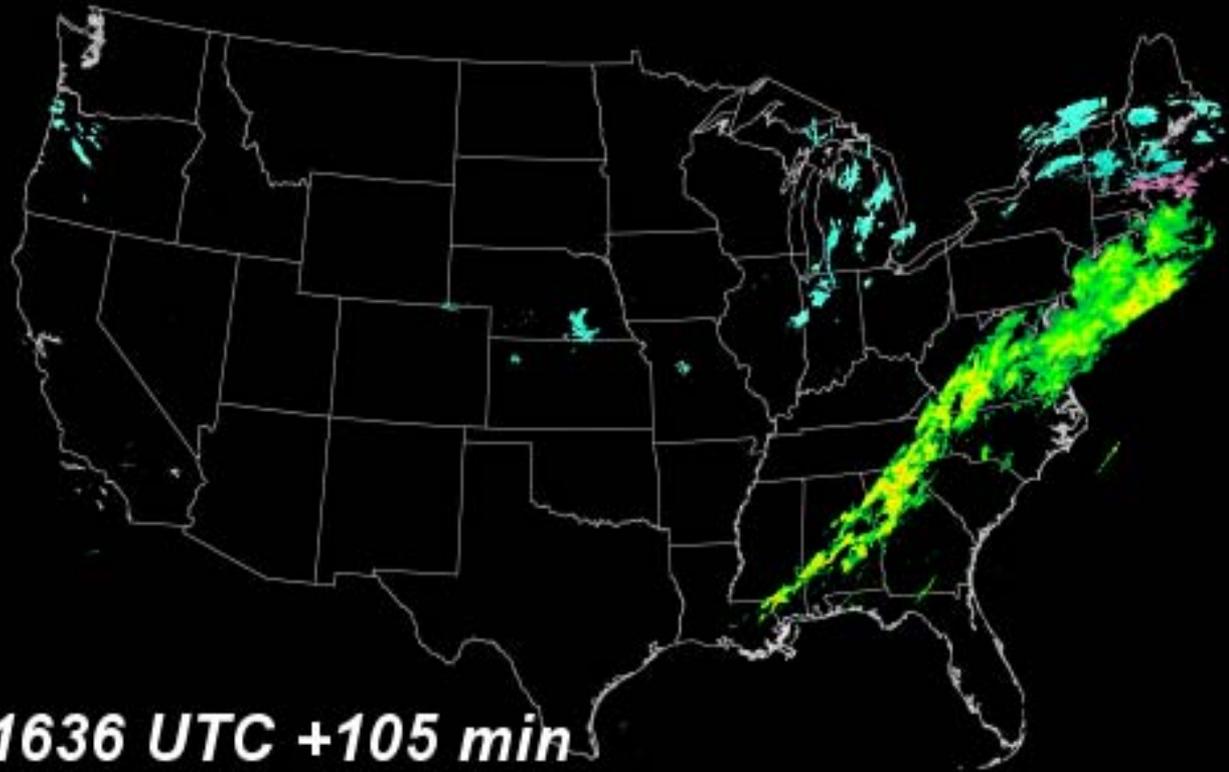
NEXRAD Forecast Product

90 Minute Forecast



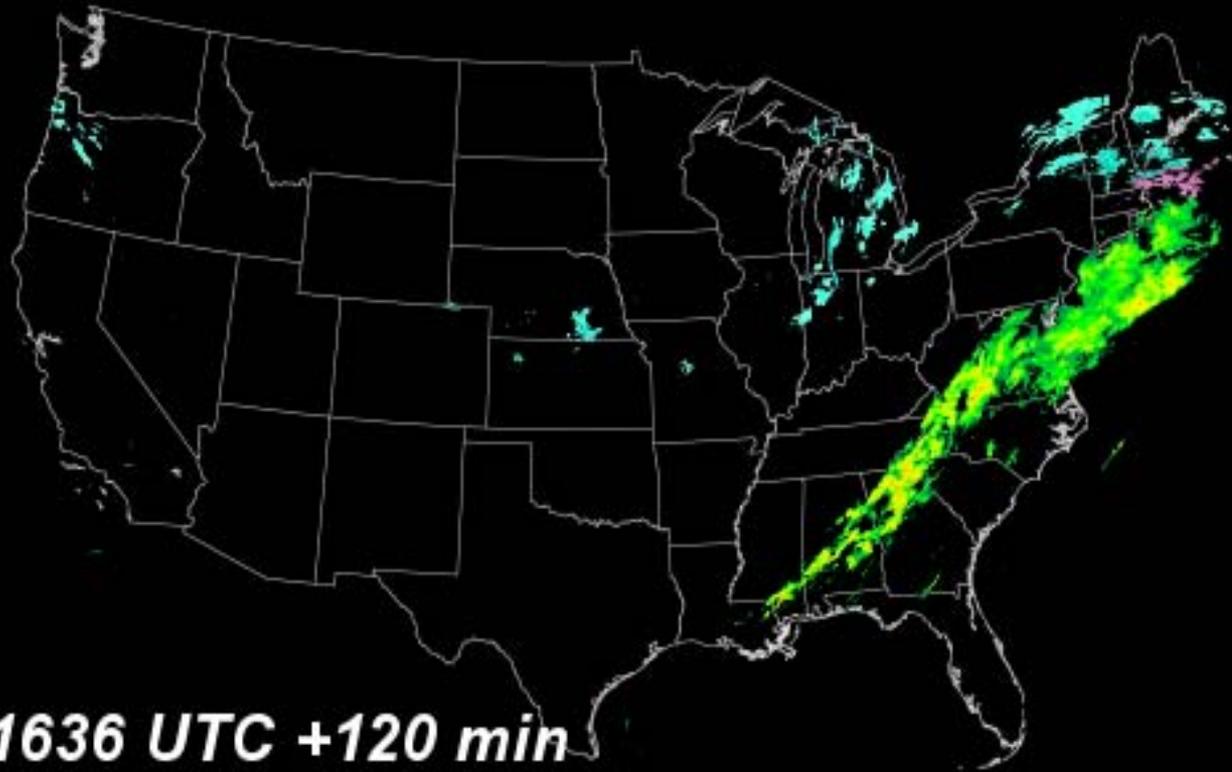
NEXRAD Forecast Product

105 Minute Forecast



NEXRAD Forecast Product

120 Minute Forecast



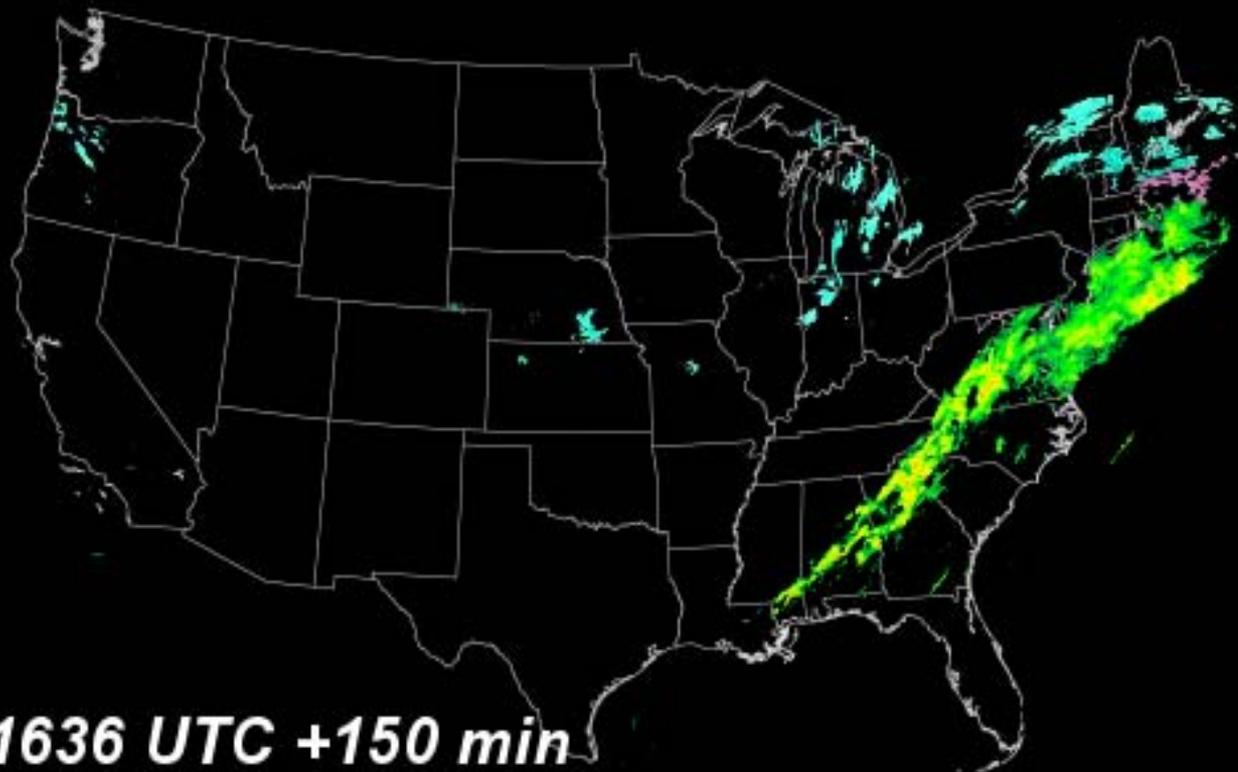
NEXRAD Forecast Product

135 Minute Forecast



NEXRAD Forecast Product

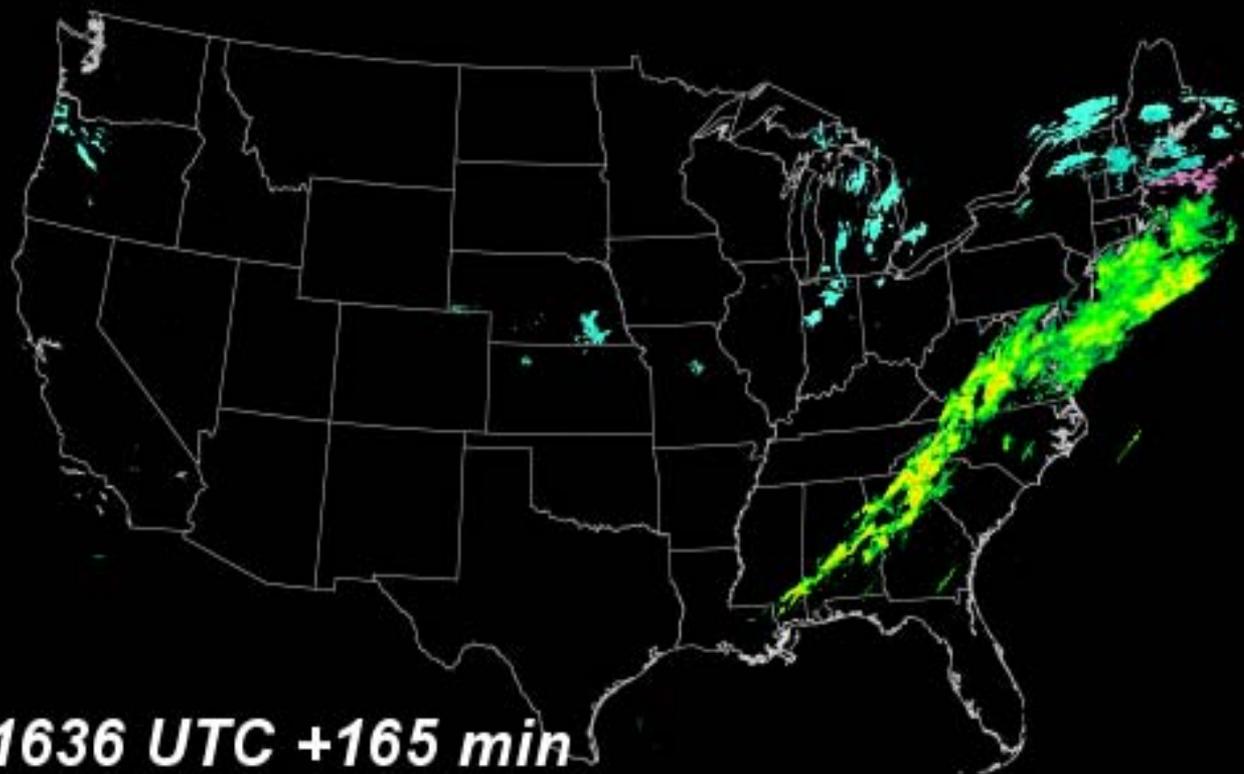
150 Minute Forecast



01-05-2004 1636 UTC +150 min

NEXRAD Forecast Product

165 Minute Forecast



01-05-2004 1636 UTC +165 min

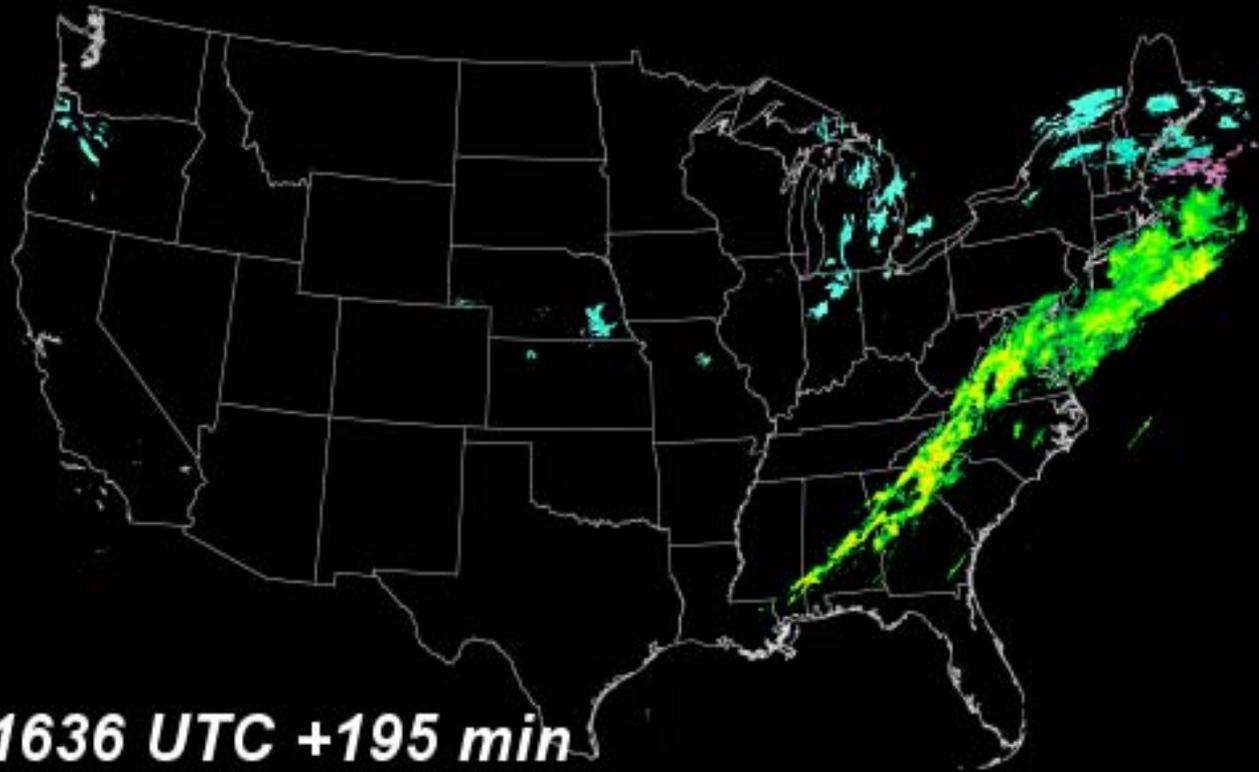
NEXRAD Forecast Product

180 Minute Forecast



NEXRAD Forecast Product

195 Minute Forecast



NEXRAD Forecast Product

210 Minute Forecast



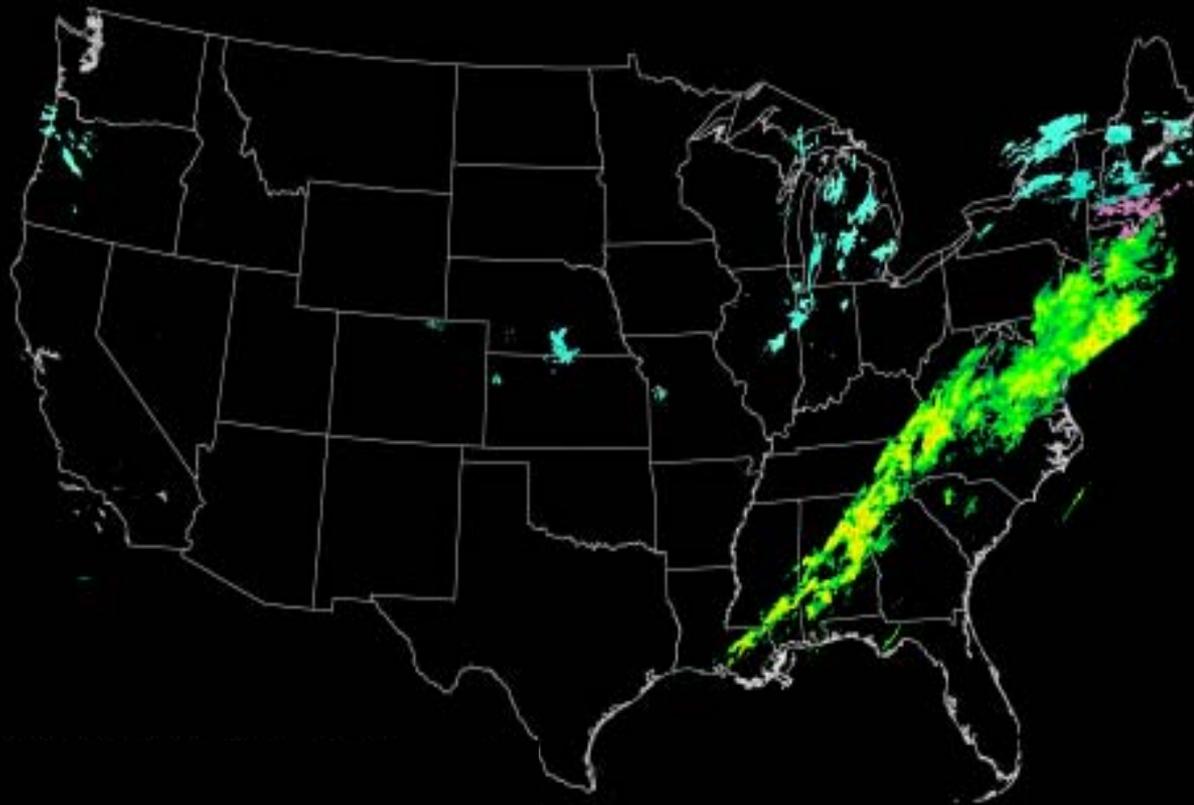
01-05-2004 1636 UTC +210 min

NEXRAD Forecast Product

225 Minute Forecast



NEXRAD Forecast Product



NEXRAD Forecast Product

15 Minute Forecast



01-05-2004 1636 UTC +15 min

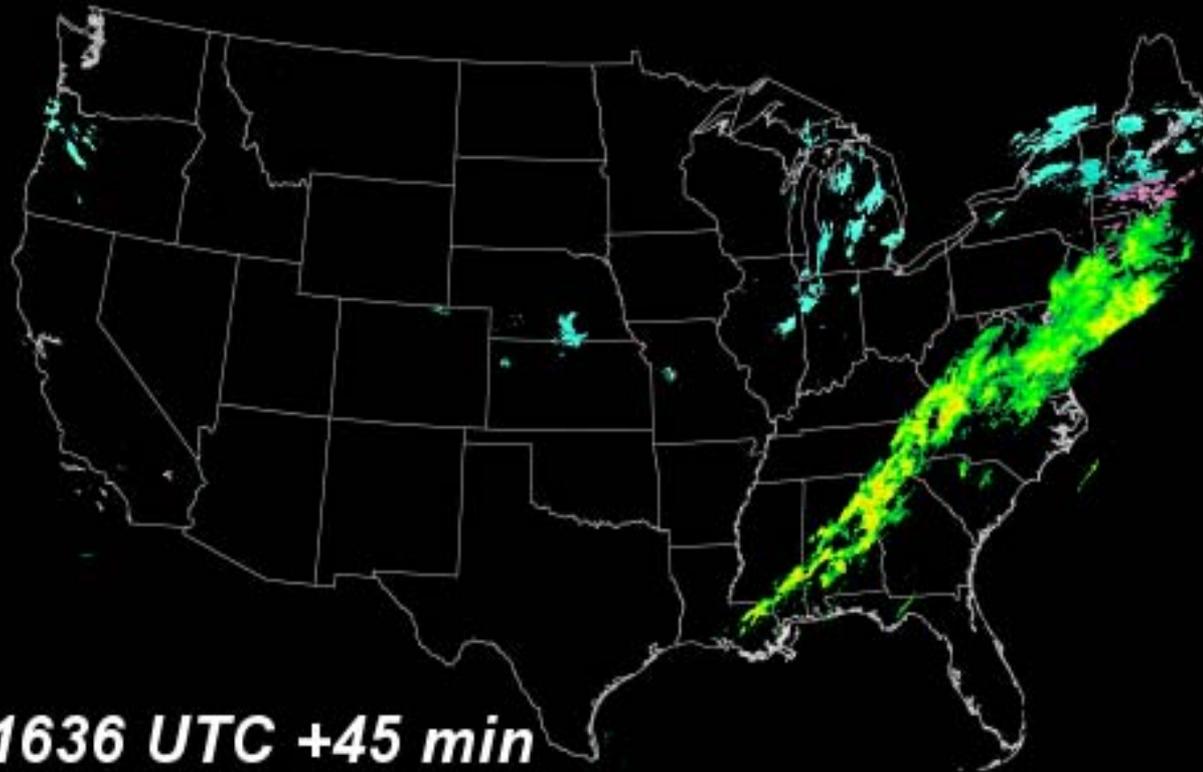
NEXRAD Forecast Product

30 Minute Forecast



NEXRAD Forecast Product

45 Minute Forecast



NEXRAD Forecast Product

60 Minute Forecast



NEXRAD Forecast Product

75 Minute Forecast



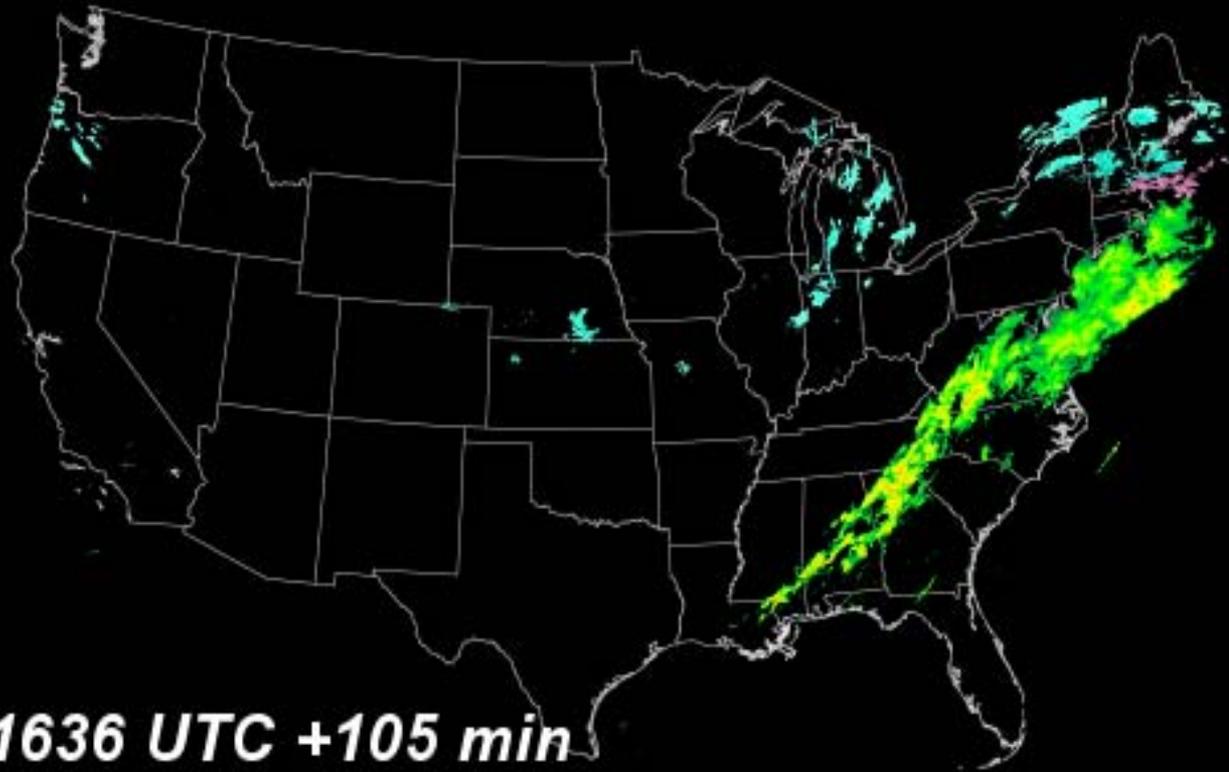
NEXRAD Forecast Product

90 Minute Forecast



NEXRAD Forecast Product

105 Minute Forecast



NEXRAD Forecast Product

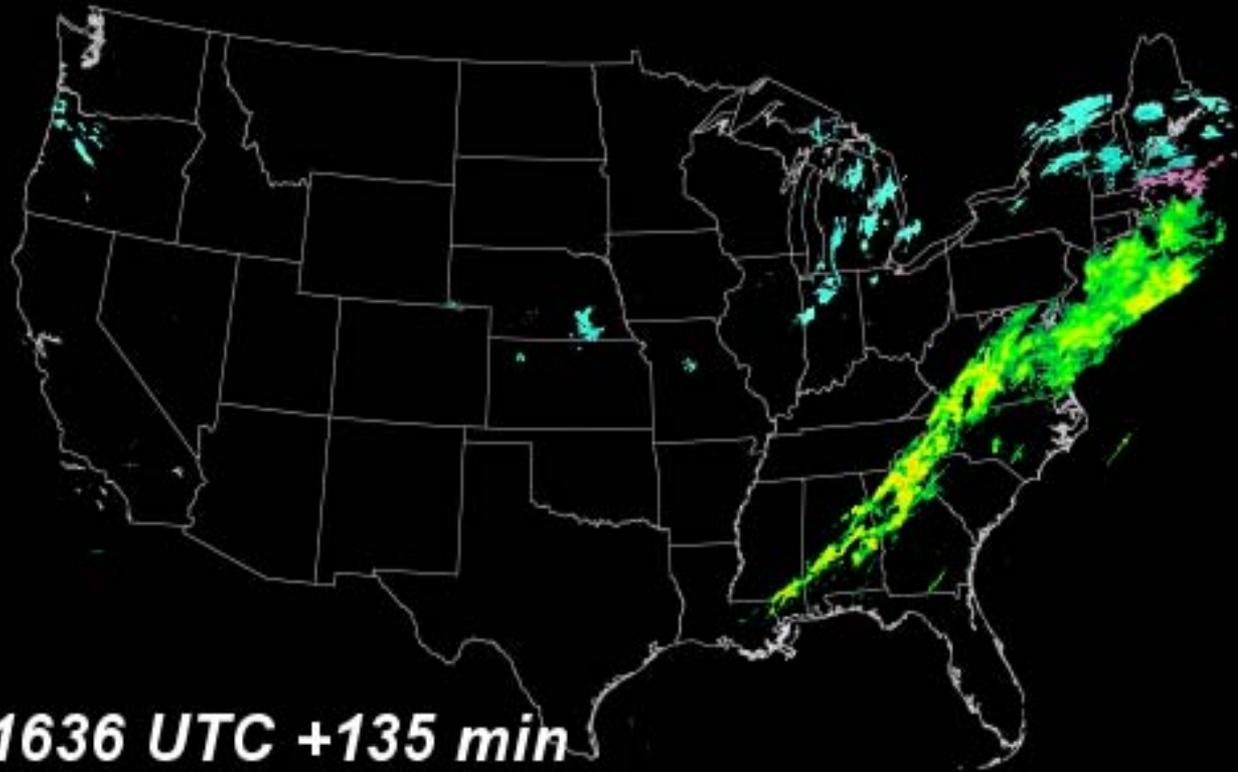
120 Minute Forecast



01-05-2004 1636 UTC +120 min

NEXRAD Forecast Product

135 Minute Forecast



01-05-2004 1636 UTC +135 min

NEXRAD Forecast Product

150 Minute Forecast



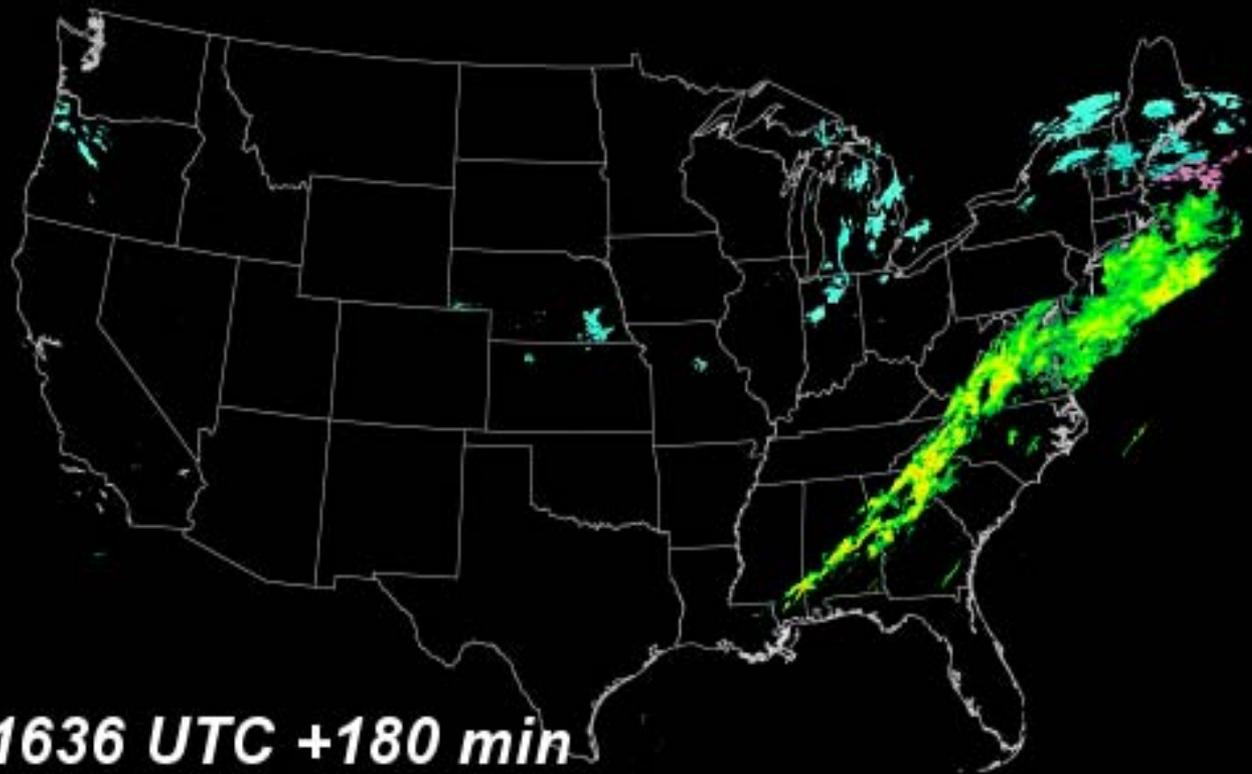
NEXRAD Forecast Product

165 Minute Forecast



NEXRAD Forecast Product

180 Minute Forecast



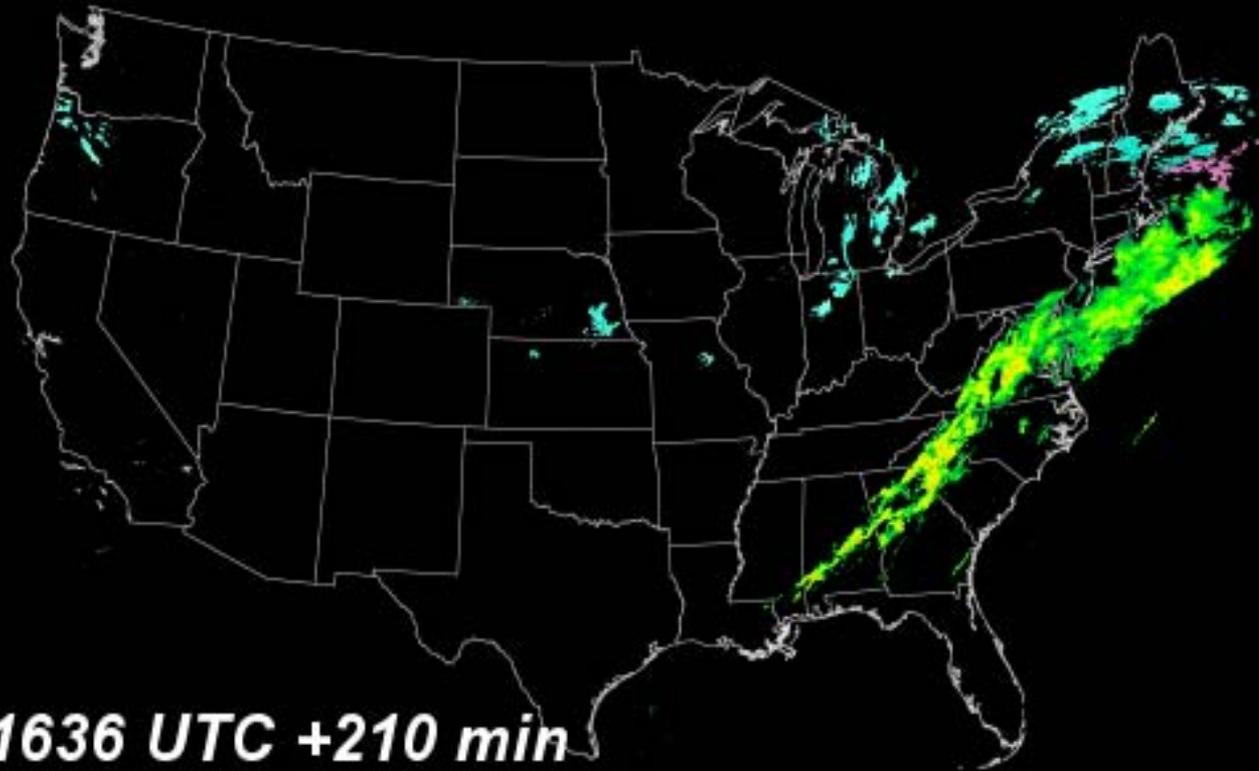
NEXRAD Forecast Product

195 Minute Forecast



NEXRAD Forecast Product

210 Minute Forecast



01-05-2004 1636 UTC +210 min

NEXRAD Forecast Product

225 Minute Forecast



NEXRAD Forecast Product Summary

- Will provide 4 hour forecasts of reflectivity nationwide updated every 15 minutes
- 2 km resolution
- Has skill out to 4-6 hours
- Shown to produce better precipitation forecasts than models out to 6 hours.
- Rain/snow/mix will be delineated in forecasts.
- Provides forecasts for convective and non-convective situations.



MAPLE Implementation For Jeppesen Customers

- Uses 2 km National Mosaics as input.
- Produces 4 hour forecast of reflectivity every 15 minutes at 2 km resolution.
- Forecasts are shown with 15 minute increments in a loop out to 4 hours.
- Uses hourly numerical model runs to determine rain/snow/mix areas & convective growth/decay in forecasts.



Case Study – 13 Apr 2004

Newark International Airport - Microsoft Internet Explorer



Due to **WEATHER, LOW CIGS**, there is a Traffic Management Program in effect for traffic arriving **Newark International Airport, Newark, NJ (EWR)**. This is causing some arriving flights to be delayed an average of **1 hour and 40 minutes**. To see if you may be affected, select your departure airport and check "Delays by Destination".

Delays by Destination:

- Due to WEATHER, LO CIGS, departure traffic destined to **The William B Hartsfield International Airport, Atlanta, GA (ATL)** is currently experiencing delays averaging **1 hour and 13 minutes**.
- Due to WEATHER, LOW CIGS, departure traffic destined to **John F Kennedy International Airport, New York, NY (JFK)** is currently experiencing delays averaging **42 minutes**.
- Due to WEATHER, LOW CIGS/VSBY, departure traffic destined to **La Guardia Airport, New York, NY (LGA)** is currently experiencing delays averaging **2 hours and 48 minutes**.
- Due to WEATHER, LOW CIGS/VSBY, departure traffic destined to **Philadelphia International Airport, Philadelphia, PA (PHL)** is currently experiencing delays averaging **2 hours and 10 minutes**.
- Due to WEATHER, THUNDERSTORMS, departure traffic destined to **John F Kennedy International Airport, New York, NY (JFK)** will not be allowed to depart until at or after **5:45 pm EDT**.
- Due to WEATHER, LOW CIGS/VSBY, departure traffic destined to **Philadelphia International Airport, Philadelphia, PA (PHL)** will not be allowed to depart until at or after **5:15 pm EDT**.
- Due to WEATHER, LOW CIGS, departure traffic destined to **Teterboro Airport, Teterboro, NJ (TEB)** will not be allowed to depart until at or after **5:35 pm EDT**.

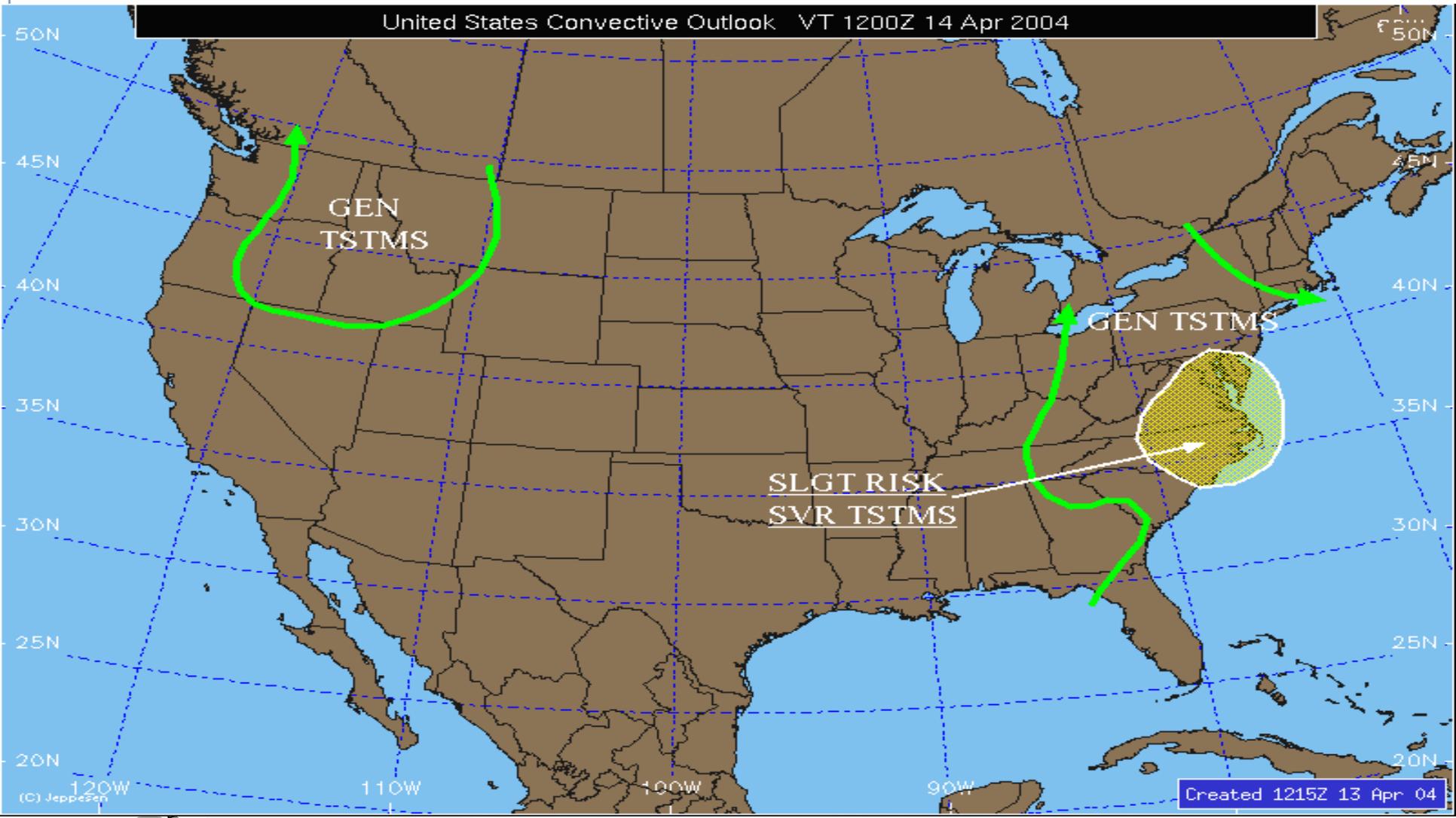
General Departure Delays: Due to WX/TSTORMS, traffic is experiencing Gate Hold and Taxi delays between **31 minutes** and **45 minutes** in length and increasing.

General Arrival Delays: Arrival traffic is experiencing airborne delays of **15 minutes** or less.

This information was last updated: **Apr 13, 2004 5:14:33 PM EDT**

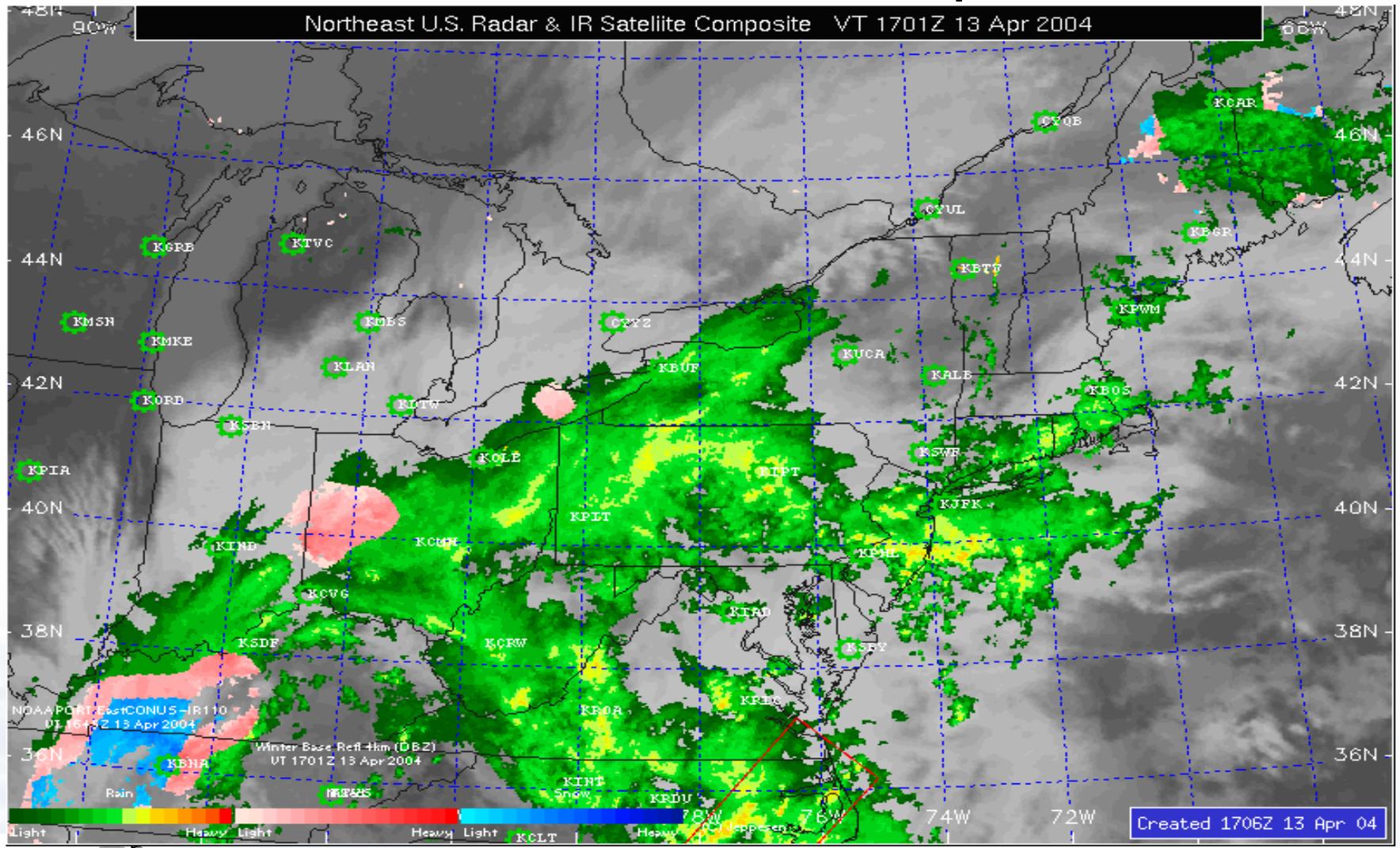


Convective Forecast – 13 Apr 2004

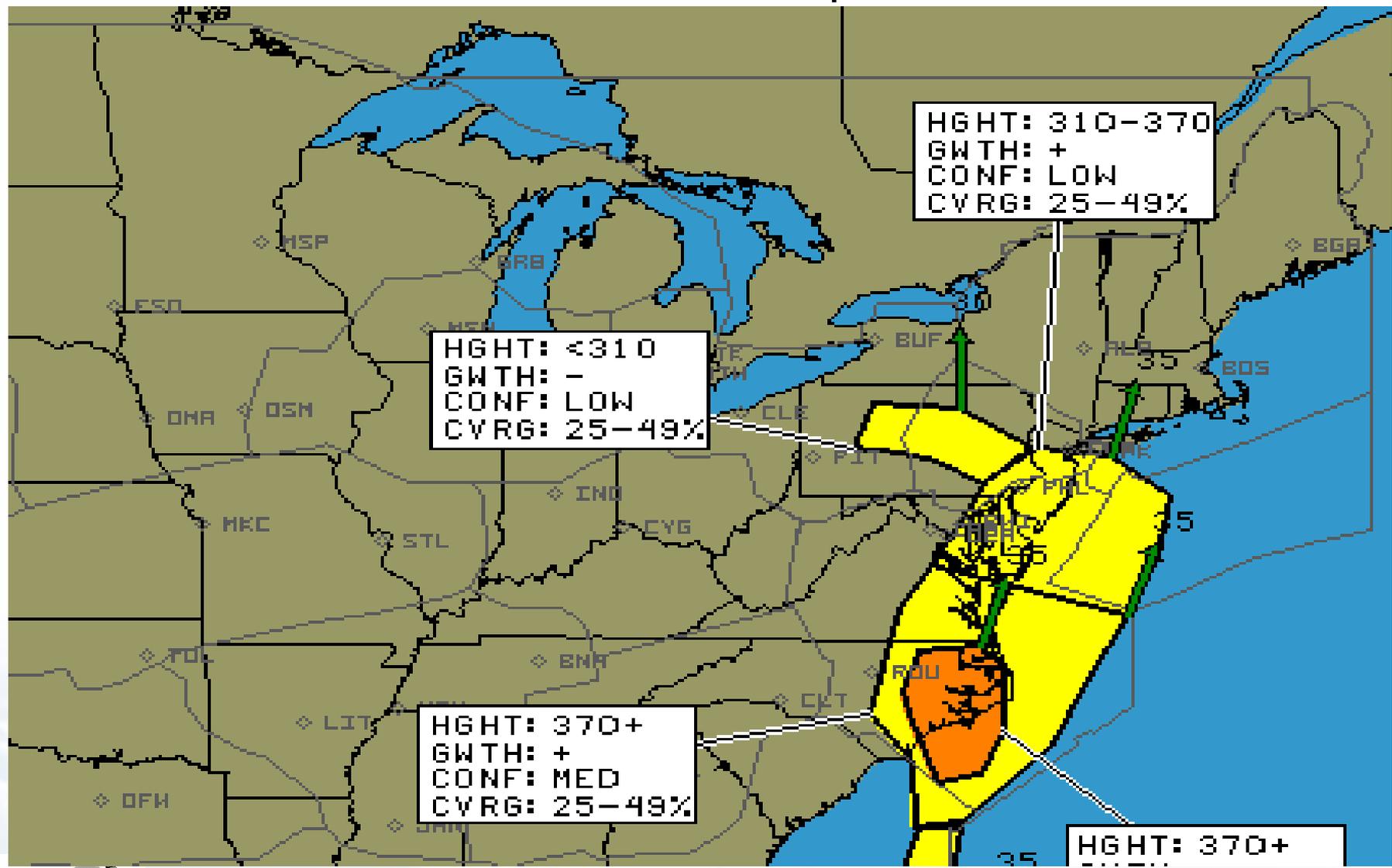


Satellite/Radar Composite

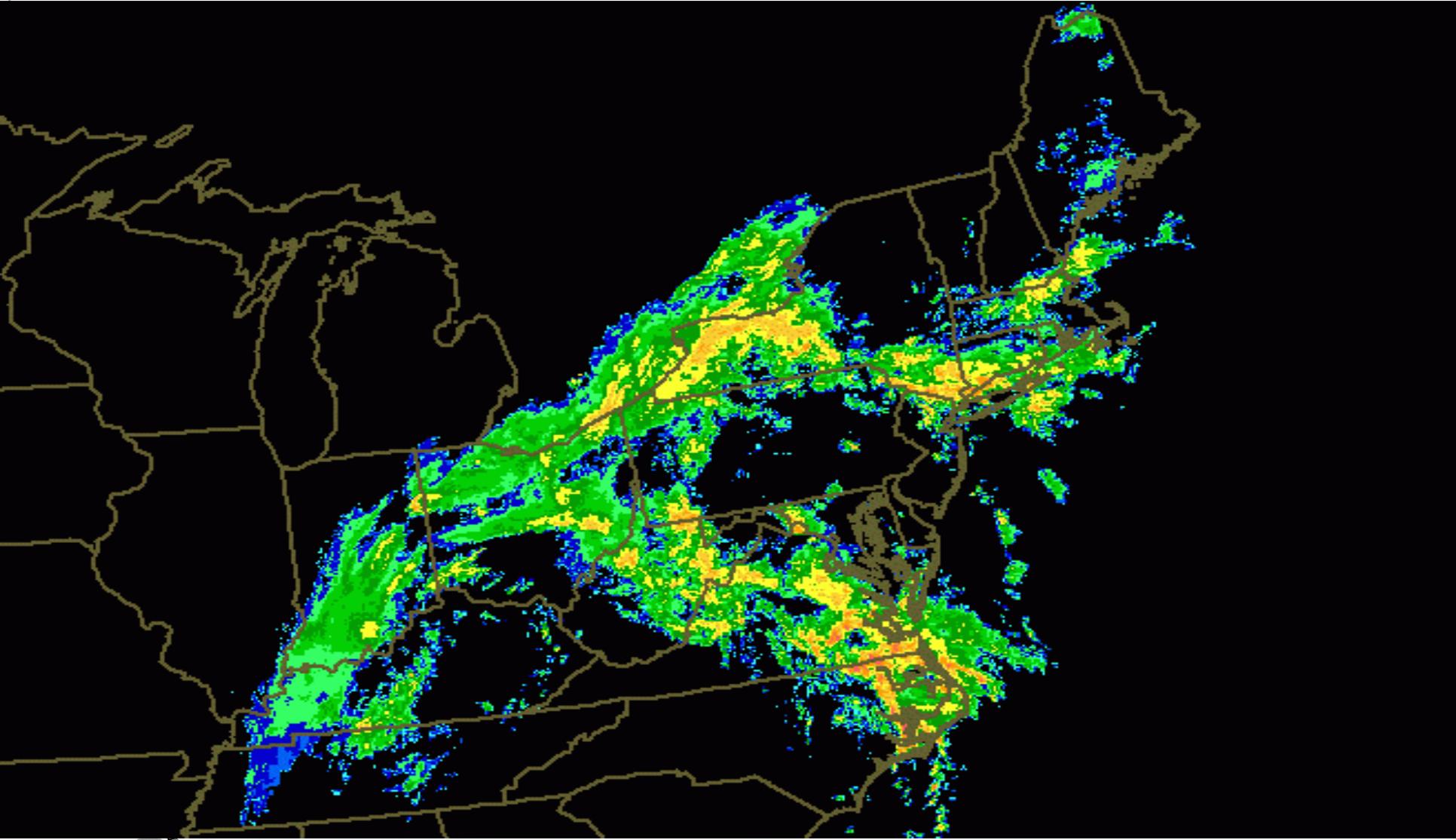
Valid 1700 UTC – 13 Apr 2004



CCFP 2 Hr Forecast Issued at 1700 UTC 13 Apr 2004 VT – 1900 UTC 13 Apr 2004

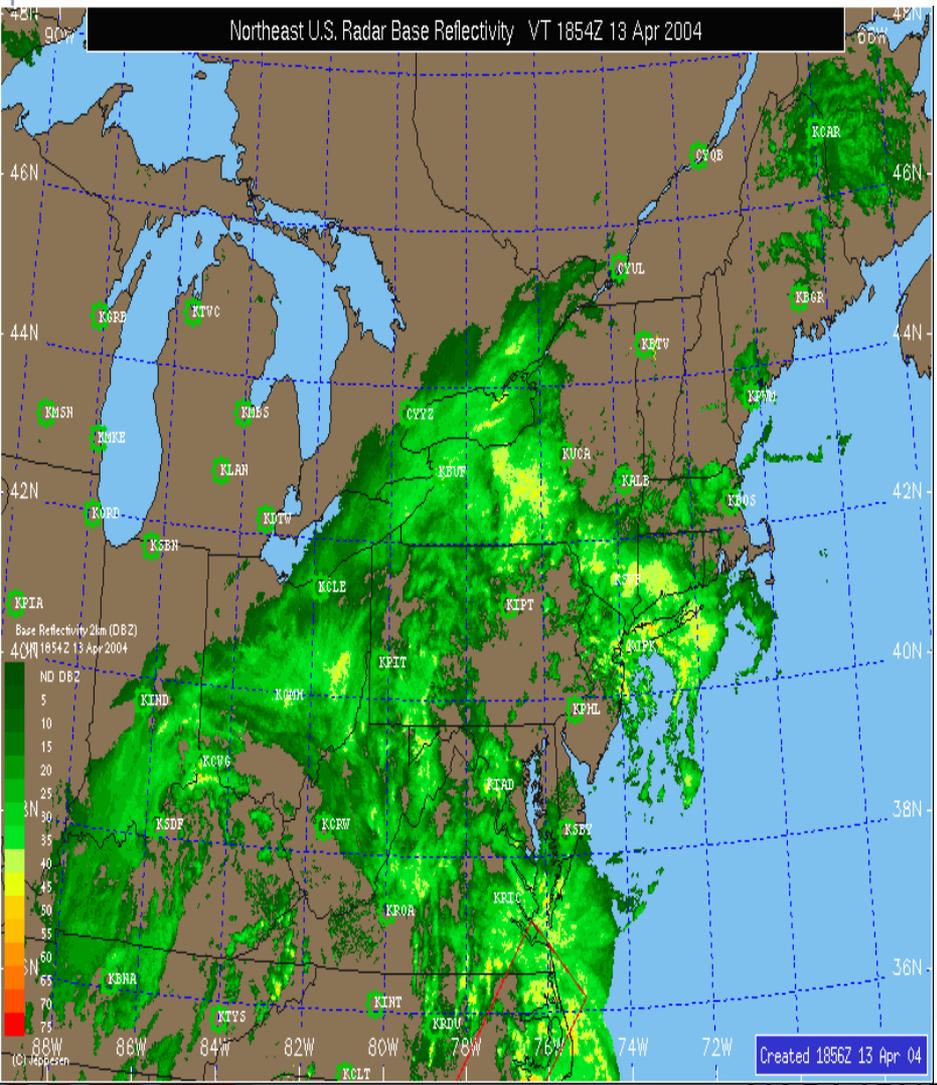


MAPLE 2 Hr Forecast Issued at 1700 UTC 13 Apr 2004 VT – 1900 UTC 13 Apr 2004



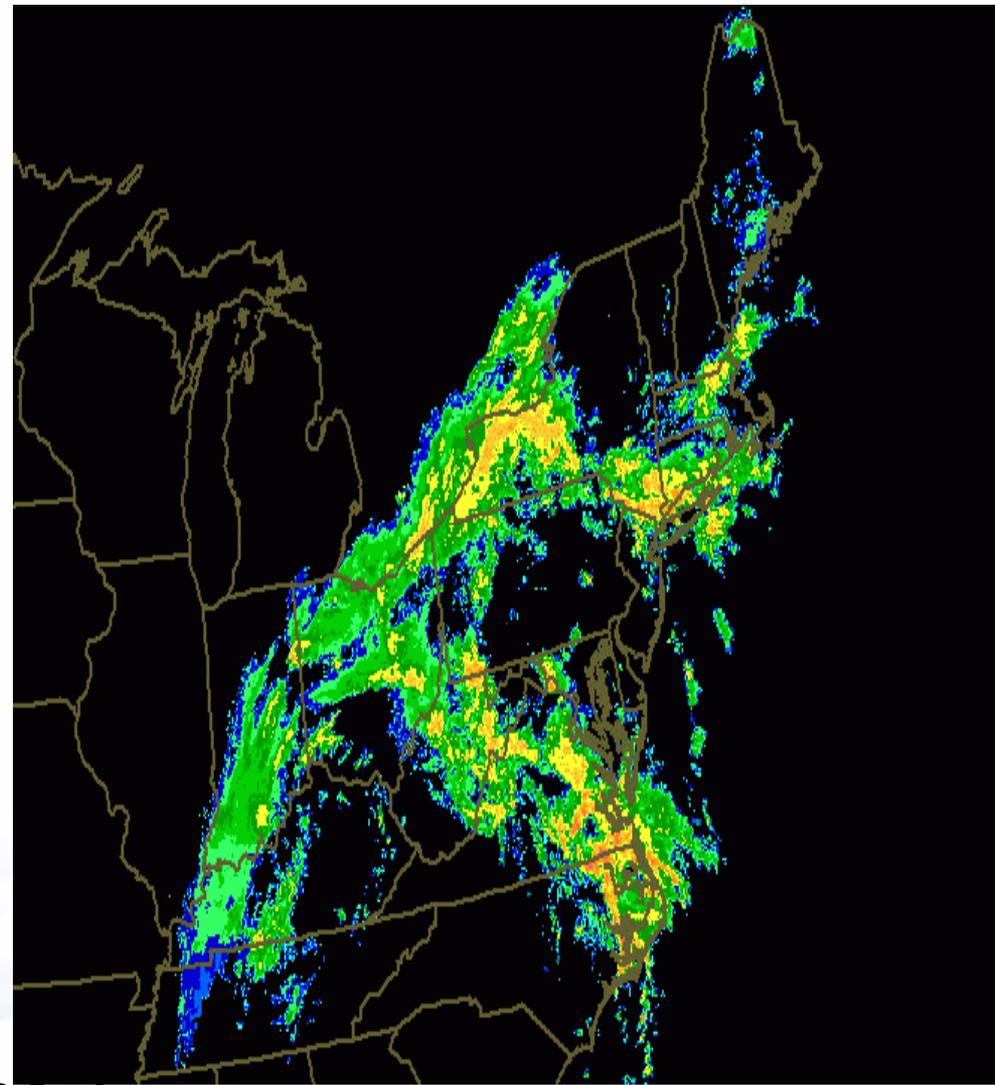
NEXRAD Analysis

Valid 1900 UTC 13 Apr



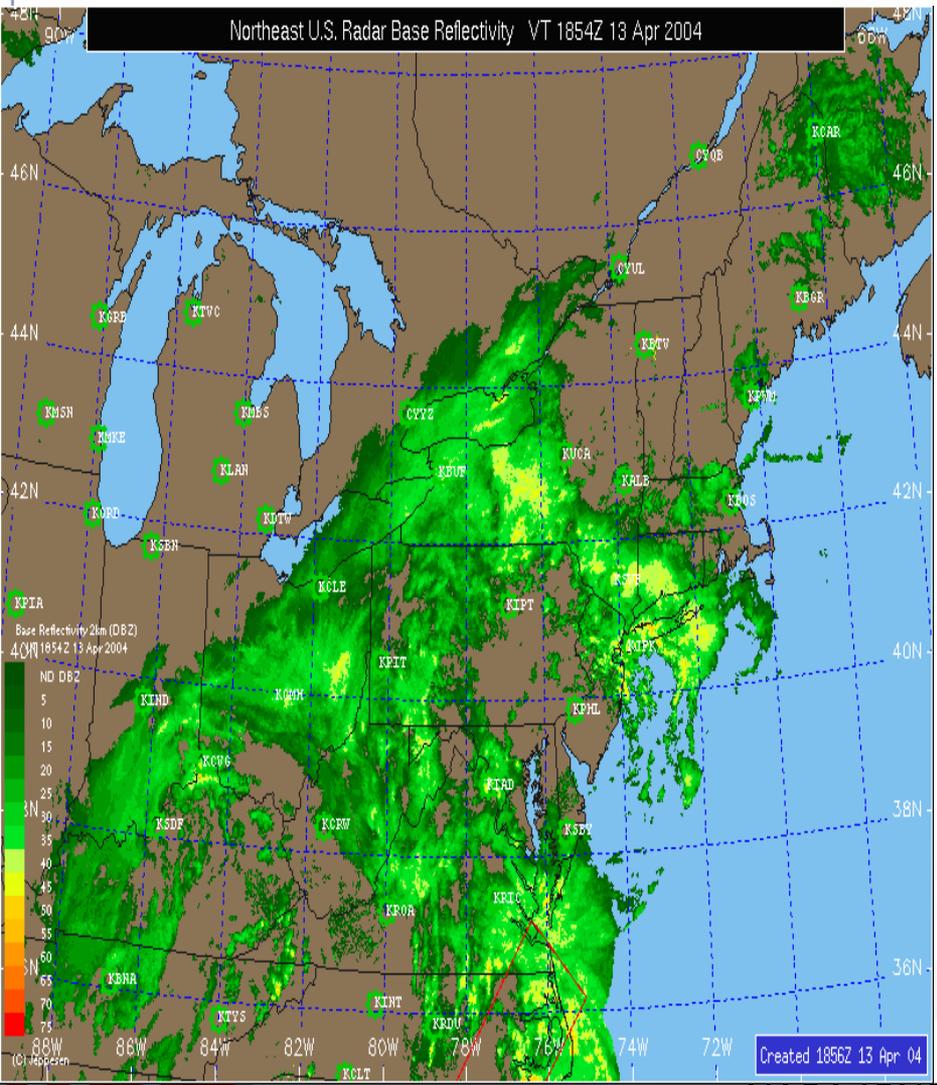
MAPLE 2 HR FCST

Valid 1900 UTC 13 Apr



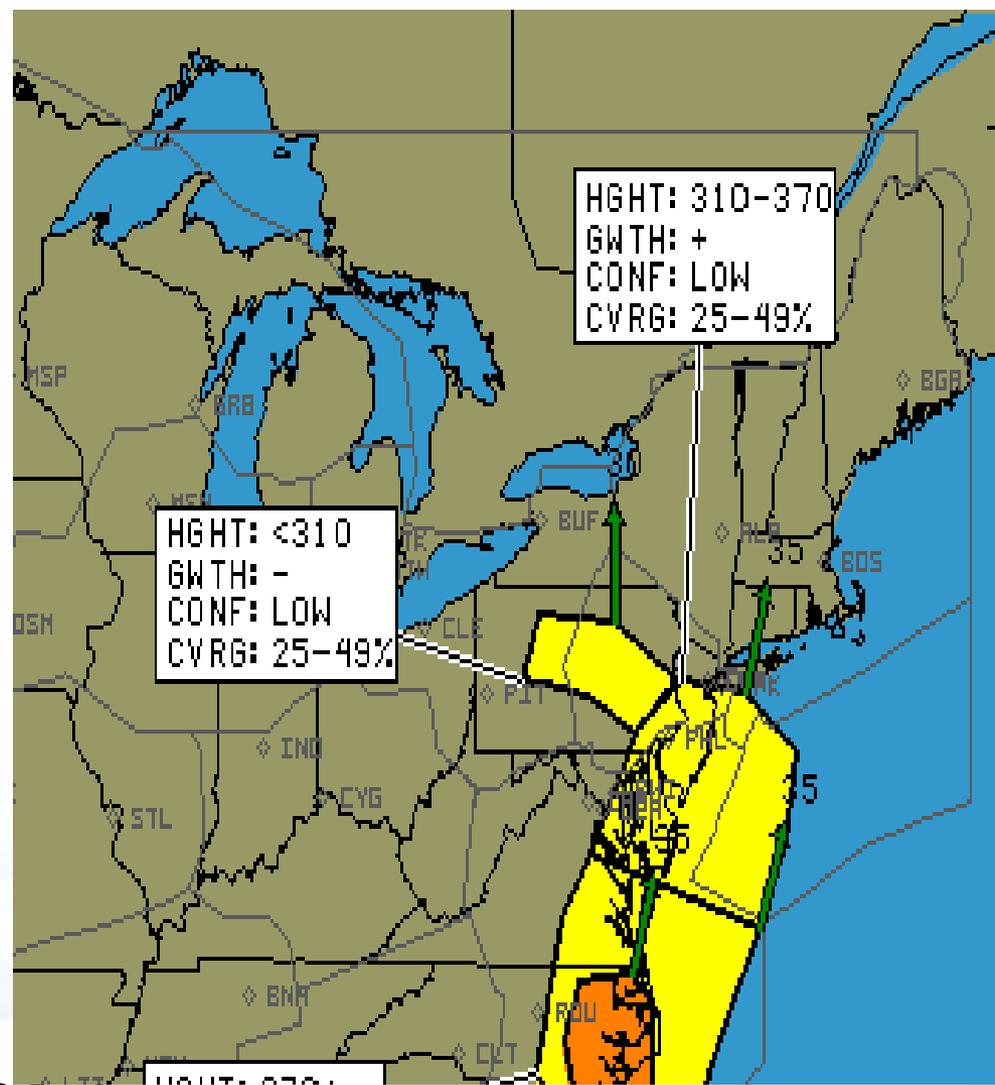
NEXRAD Analysis

Valid 1900 UTC 13 Apr



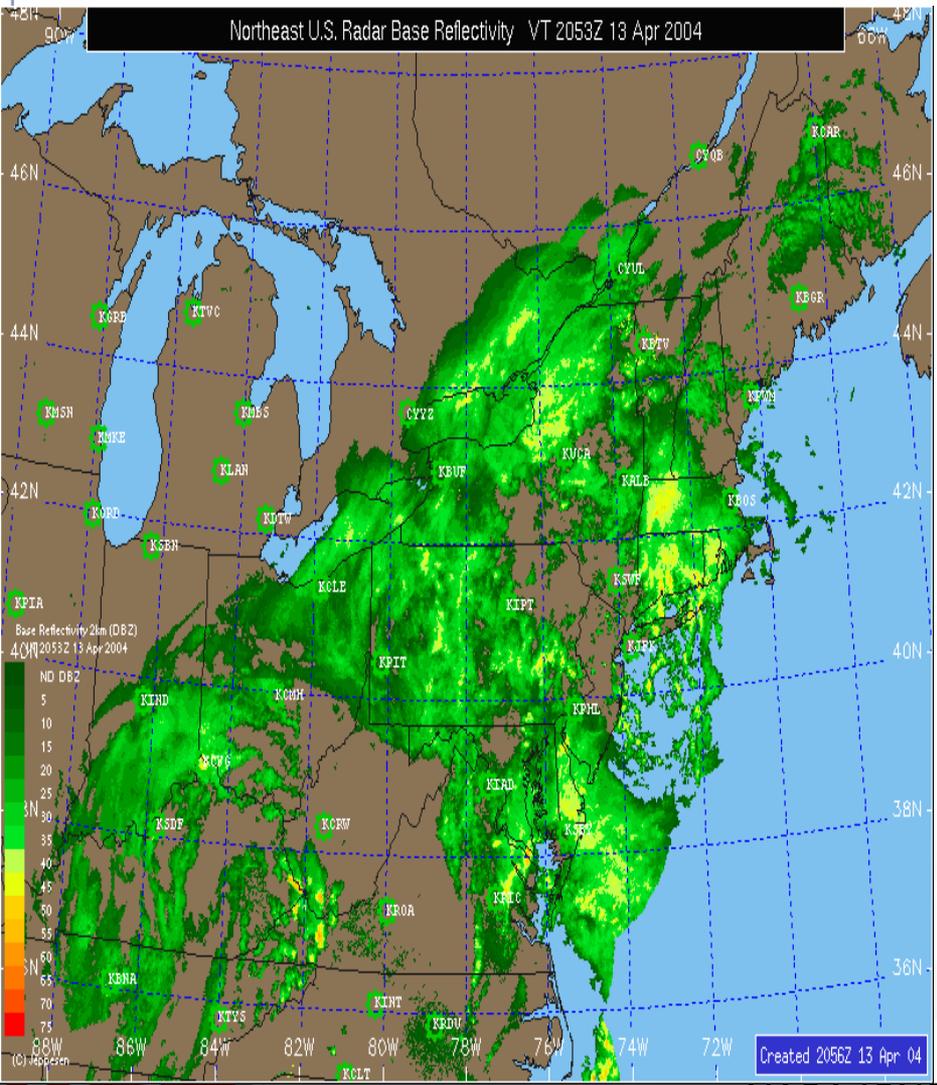
CCFP 2 HR FCST

Valid 1900 UTC 13 Apr



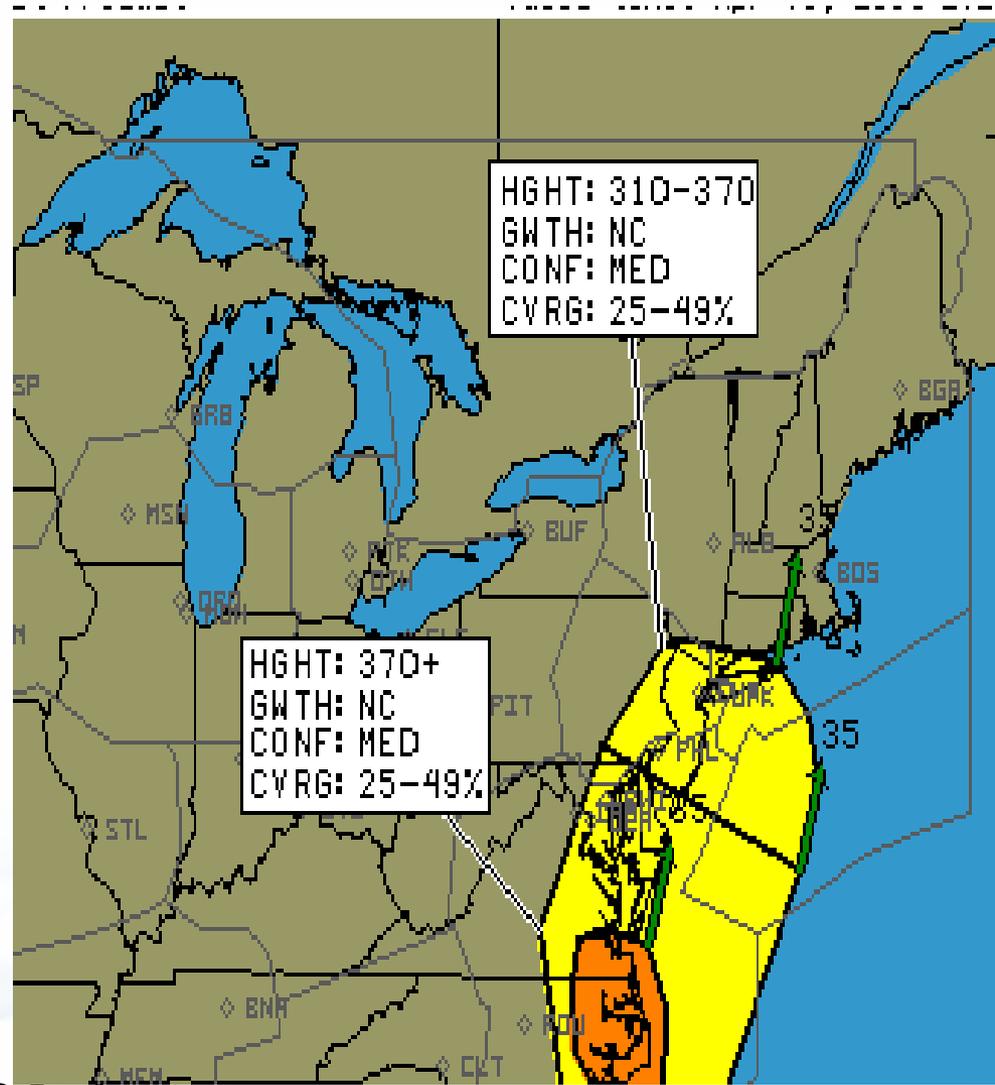
NEXRAD Analysis

Valid 2100 UTC 13 Apr



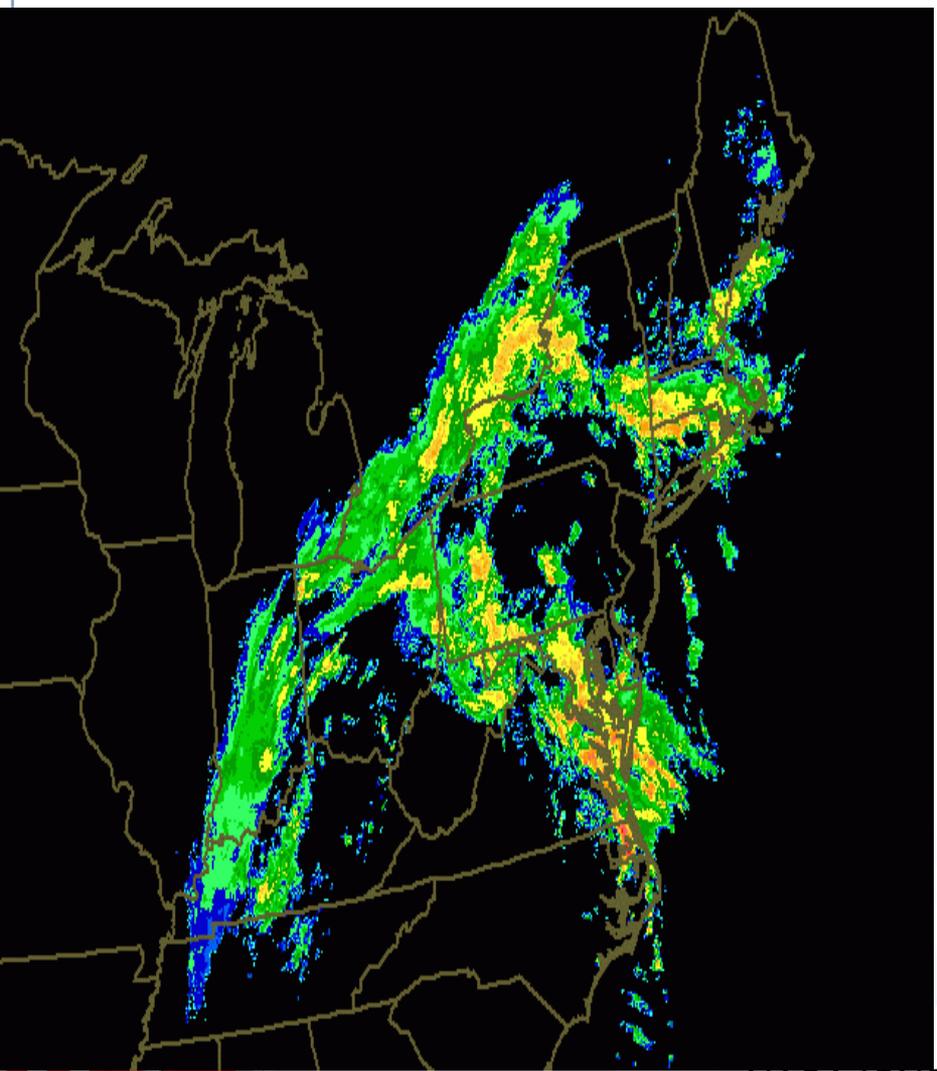
CCFP 4 HR FCST

Valid 2100 UTC 13 Apr



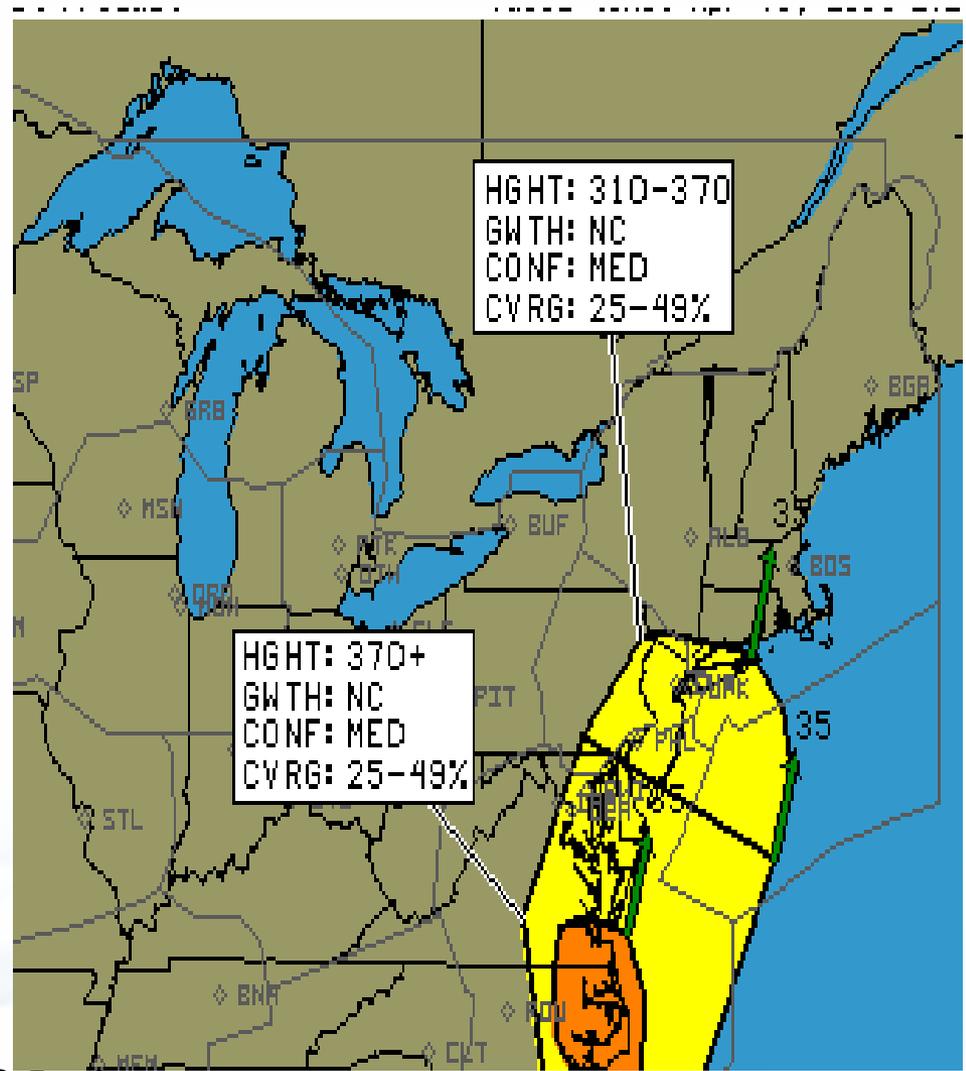
MAPLE 4 HR FCST

Valid 2100 UTC 13 Apr



CCFP 4 HR FCST

Valid 2100 UTC 13 Apr



Jeppesen & WDT MAPLE NEXRAD Forecast

- Improved Convective Forecast Accuracy
- Improved Convective Forecast Resolution
- Improved ATC Flow Management Capability
- Improved Air Traffic Routing
- Reduced Delays
- Fuel & Cost Savings

Available from Jeppesen in July 2004

